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ANNUAL REPORT

OF THE

COMMISSIONER

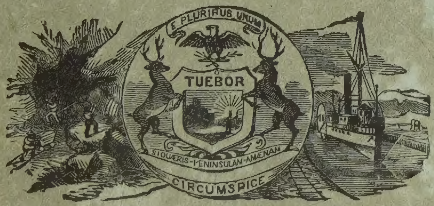
OF

MINERAL STATISTICS

OF THE

STATE OF MICHIGAN.

FOR 1884. 1883



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HON. JOSIAH W. BEGOLE, *Governor of Michigan:*

DEAR SIR:—I have the honor to present herewith my report as Commissioner of Mineral Statistics for the year 1883. That it is not so elaborate as you may have had reason to anticipate, is due to the fact that my predecessor, in his report for 1882, very fully described nearly, if not quite, all the mines as they existed up to as late a date as the middle of the succeeding year, as he himself states. Aside from this, many of the mine owners express themselves as being averse to the publication of anything more than the statistics of production, and not a few have suggested to me that the report should be confined, in addition to the usual statistical tables, to a mere record of the development of new mines, and of such improvements, additions and innovations as relate solely to the perfection of our mining system, to the end that all may have the benefit of whatever may be proved best and most desirable in the way of mine machinery and appliances. In this I am inclined to agree with them; but in my next report I shall follow in the footsteps of my predecessor and fully describe each and every mine of whatsoever kind in the State. To do so in this report however, would, in a large measure, be simply a repetition of facts already given to the public through this office; I have therefore confined myself to a brief statement of the condition of the copper mines at the close of 1883, to the developments in the new iron fields in Ontonagon County, as also of the discovery of the precious metals in the Upper Peninsula, and the now almost absolute certainty of gold and silver being added to the other mining industries of the State. I have also devoted a brief chapter to the slate beds of Baraga County, in the development of which not much progress has been made, though in my opinion they are destined to be made ere long the basis of a large and profitable industry. I have not, for the reason stated, treated of the iron mines in detail, but the chapter on Isle Royale will, I think, be found interesting, as directing favorable attention

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to that most isolated but by no means least valuable portion of our great State.

The delay in making this, my first report, is due to the unlooked for demand made upon my time in connection with the Michigan State Exhibit at the New Orleans Exposition. When I accepted the appointment of U. S. Commissioner for Michigan, I did so without a proper appreciation of the labor it would devolve upon me; but having undertaken the work, I found when too late that I could not resign the position without hazarding the interests of the State at the Exposition. I therefore hope and trust that the time and labor expended in behalf of a proper representation of our State at New Orleans may be accepted as a sufficient excuse for being later with this report than I otherwise should have been.

In the collection of the material for this report I have had the assistance of J. Parke Channing, M. E., who visited and inspected most of the copper mines, and of Chas. F. Howe, M. E., who made the trip with me through the Agogeebic Iron Range. These able and accomplished young gentlemen have been engaged to render like service in the examination of the mines preliminary to the preparation of my report for 1884, which I design making very full and complete in all respects, and which will be accompanied with maps, diagrams, and illustrations of all the principal copper and iron mines. This second report is already under way, and will embrace a great deal of material which would have been given herewith, but that I have deemed it best not to include parts of two years in each report, neither being complete as to the year to which it is credited.

Very respectfully, your obedient servant,

A. P. SWINEFORD.

Marquette, Mich., 1884.

COPPER.

I regret being compelled to report that the copper industry is not in as prosperous a condition as at the date of my predecessor's last annual report. Since then there has been a very material decline in prices — indeed, never in the history of copper mining in this State has the price of copper ruled so low as during the years 1883-4. This fact, while no doubt chiefly attributable to the general depression in all branches of business, is likewise in part the result of a production exceeding the wants of the home market. A very considerable portion of the product was sold abroad, and the amount so sold fixed the price of the greater portion of the aggregate which was sold for home consumption. It is questionable, in the case of our copper mines, whether "protection" really protects; the price of copper, notwithstanding the protective duty on the imported article, has fallen below the limit at which it can be made at a considerable number of our mines without loss, and I see no alternative for some of them than a suspension of operations, unless something shall occur to increase the home demand, bringing with it better prices. The cheapening of prices, however, may not be without its compensating benefits, in the way of suggesting various uses for which copper is not only adapted, but in which it is far more desirable than any other material. The press of the Upper Peninsula — notably the Portage Lake Mining Gazette and the Marquette Mining Journal — have been doing a good work in this direction, and it is not improbable that through their efforts several new channels for the consumption of copper may be opened up to our miners. Architects and builders have, according to these journals, no hesitation in pronouncing in favor of copper for roofing purposes, as being far preferable to any other material, having due regard to durability as well as economy. A "new process," arrived at by Jas. R. Cooper, Esq., of the Detroit and Lake Superior Copper Company, after long study and much experimenting, is likely to have an important bearing in this direction, in that it will create a demand for copper for purposes in which it has hitherto been unavailable. It consists simply in smelting the copper in a crucible after it has been refined in the ordinary way. The smelting must be done in the presence of sufficient carbon to extract all the oxygen from the metal; it must also be poured in such a way that it will not come in contact with the atmosphere, or the metal will again absorb oxygen. All cast copper refined in the ordinary way carries a small amount of oxygen distributed through it, and it is that which causes the copper to harden so rapidly when it is rolled, or drawn into wire, and if the rolling and drawing is carried too far the sheet cracks and the wire breaks. The deoxidized copper will harden during the process of rolling or drawing, but not so rapidly as to cause it to crack or break. If desired, the deoxidized copper, as made by Mr. Cooper's process, can be worked cold at the commencement; but ordinary refined bars must be heated before they are passed through the rolls. Hard drawn wire, made from deoxidized copper, has a greater tensile strength than common wire, and it can be bent and twisted as much as the annealed wire made from ordinary copper, before it breaks. Deoxidized copper is lighter in color, and has a higher specific gravity than the common article. It is said that common copper wire is soon destroyed about all large cities, from the fact that the sulphurous gases attack that portion of the copper which is combined with oxygen, and dissolve it, causing the wire to become porous, and finally destroying its strength and conductibility. It is claimed that the deoxidized copper cannot be attacked and destroyed in that way, as the gases act very slowly, if at all, on copper not combined with oxygen.

Should all that is claimed for this "new process" be realized, it is believed that copper wire will supersede that now in use for telegraph and telephone purposes — copper wire being much the better conductor. In that event a home demand fully equal to our present surplus will have been created, in addition to that which may result from the other new channels of consumption to which the attention of those interested is being steadily and constantly directed. Herein lies at least one of the ways of salvation for our copper mining industry.

ISLE ROYALE,

One of the Counties of the State, and perhaps the only one without a permanent resident, has heretofore been the field of a number of unsuccessful mining ventures; still, I venture the prediction that it will yet become a most valuable adjunct to the present developed copper district of Michigan, if indeed it does not ultimately attain an equal prominence as a mining center. Since my appointment as commissioner I have made two visits to this most interesting island, concerning which very little has been said or written during the past two or three decades. The island constitutes the county of the same name—once organized, but at present, as I have stated without a single permanent inhabitant—without officers, because there are no voters to elect them. The island has a length of about forty-five miles, with a varying width of from four to seven miles. It is a most beautiful and interesting island, singularly formed, cut up into deep bays and sending out long spits of rock at its north-eastern extremity, while at its south-western end it shelves off far into the lake, presenting slightly inclined beds of red sand-stone, tabular sheets of which for miles from the coast are barely covered with water, and offer dangerous shoals and reefs on which vessels, and even boats, would be quickly stranded if they endeavored to pass near that shore. All this is different on that portion of the coast where the rocks are of igneous origin. In attempting to describe the island I cannot do better than draw upon and condense from Dr. Jackson's report, made in 1849, just after he had visited the island, and must have seen it in all its native loveliness. "Natural harbors are so numerous that every part of the island is within short distance of one—a fact very important as bearing upon the cost of transportation to and from any mine that may hereafter be developed and successfully wrought. Rock Harbor is the largest and most beautiful haven on Lake Superior, is deep enough for any vessel, and perfectly secure from any wind. Siscowit Bay is its counterpart, except that it is exposed to a north-east wind, and lacks the numerous islands which stand like so many castles at the entrance of the other to protect it from the heavy surges of the lake. In some respects Rock Harbor represents the Bay of Naples, with Procida, Capri and Ischia at its entrance; but no modern volcano completes the background of the picture, notwithstanding the traditions of there having been earthquakes and eruptions in pre-historic times on Isle Royale. Igneous rocks constitute more than four-fifths of the island, and there must at one time have been greater eruptions there than ever took place in Italy; but this was at a period anterior to the existence of human beings on the globe. Bold cliffs of columnar trap and castellated rocks, with mural escarpments, sternly present themselves to the surf and defy the storms. The waters of the lake are deep close to the very shores, and the largest ship may in many places lie as close to the rocks as at an artificial pier. The color of the water, affected by the hue of the sky and holding no sediment to dim its transparancy, presents deeper tints than are seen elsewhere on the lakes—deep tints of blue, green and red prevailing, according to the color of the sky and clouds. Added to the fantastic irregularities of the coast and its castle like islands—the abrupt elevation of the hills inland rising like almost perpendicular walls from the shores of the numerous beautiful lakes which are scattered through the interior of the island, and corresponding with the lines of the mountain upheaval—are to be seen occasionally rude crags detached from the main body of the mountains, and in one place two lofty twin towers, standing on the hill-side, rise perpendicularly like huge chimneys to an elevation of 70 feet, while they are surrounded by the deep, green foliage of the primeval forest. In the deep valleys which traverse the interior of the island, between the hills, there are either small lakes or swamps filled with a thick growth of cedar trees. On the hills there is a mixture of maple, birch, spruce, fir, and pine trees, which are of thrifty growth and capable of affording both timber and fuel. The soil, formed by the decomposition of trap rocks, is warm and fertile, and so far as cultivation has been attempted has proved fully equal to that of the trap ranges of Nova Scotia."

The first historical mention of Isle Royale is to be found in a small duodecimo volume of less than two hundred pages, published at Paris in 1640, by Pierre Boucher, who says: "In Lake Superior there is a great island which is fifty leagues in circuit, in which there is a very beautiful mine of copper; it is found also in various places in large pieces all refined." In the *Relacion* for 1866–7, occurs the following reference to Isle Royale: "Advancing to a place called the Grand Anse (Great Bay) we meet with an island which is celebrated for the metal which is found there, and for the thunder which takes place, for they say it always thunders there (Thunder Cape). But further towards the west, on the same north shore, is the island most famous for copper, called Minong (the good place). This island is twenty-five leagues in length; it is seven leagues from the main-land, and sixty from the head of the lake. Nearly all around the island, on the water's edge, pieces of copper are found mixed with pebbles, but especially on the side which is opposite the south, in principally a certain bay which is near the northeast exposure to the great lake. There are shores '*tous escarpez de terre glaize*,' and there are seen several beds or layers of copper, one over the other, separated or divided by other beds of earth or rocks. In the water is seen copper sand, and one can take up in spoons grains of the metal big as an acorn, and others as fine as sand. This island is almost surrounded with islets, which are said to be composed of copper, and they are met with even to the main-land of the north." On the map made by the Jesuit fathers in 1670, the island referred to was designated Minong, its delineation exactly corresponding to the description given in the *Relacion*. The "certain bay which is near the north-east exposure to the great lake," where "there are seen several beds or layers of copper" was undoubtedly what is now known as Rock Harbor, on the shore of which the first mine on the island was opened nearly two hundred years afterwards.

Alexander Henry, who was the projector of the first mining enterprise on Lake Superior of which we have any account, does not appear to have visited Isle Royale, but confined his operations to the region about Ontonagon—where, near the spot where the famous mass was found in the river, he drove an adit into the hill-side—and to sinking a shaft the following year (1773) in a small vein on the north shore. So we have no account of the island, the name of which was probably changed to Isle Royale soon after the conquest of Canada by the British, nor even any published reference to it that I can find, until the publication of Foster & Whitney's report in 1849. The linear surveys were commenced, in 1846 or 1847, under the direction of a Mr. Ives, who was engaged in the work when Profs. Jackson and Whitney began their geological examination in 1847, and when Messrs. Dickenson and McIntyre were sent over on a similar errand by Dr. Jackson, the following year. From Hon. Samuel W. Hill, the veteran miner and explorer, who was one of the Foster & Whitney party, and who has since then devoted much time to a careful exploration of the island, I am indebted for many interesting facts herein related.

It is a little singular that no mention is made in the Foster and Whitney report of the ancient pits, of which Mr. Hill says there are more on Isle Royale than were ever found in all other portions of the copper district combined. All over the island the evidences of the copper veins having been worked by a pre-historic race are found in abundance, not only in the pits themselves, but in the shape of vast numbers of stone hammers, and an occasional copper implement. These are the only relics the ancient miner left behind him; neither the vestige of a habitation, a grave, or a skeleton, has ever been found. Among the Indians who have inhabited this region from the advent of the white man in the seventeenth century, neither legend or tradition exists giving the faintest clue to the identity of these ancient miners. At the Minong mine, McCargoe's Cove, there is an aggregation of these ancient pits extending over a length of nearly two miles, and covering an average width of 400 feet, the successive pits indicating the mining out of the belt, which is solid rock, to an average depth of at least twenty feet. Scattered all over the intervening ground are millions of battered stone hammers, many of which have been grooved by manual attrition or impact in order to fit them for the withe handles with which they were undoubtedly supplied. The process of mining seems to have been to heat the embedding rocks by building fires on the outcrops of the veins or belts, and thus partially disintegrate the rocks by the contraction produced by the sudden throwing on of water, and then completing the removal of the native masses by knocking off the adhering particles of rock with the stone hammers. This is proved by the presence in all of the ancient pits of large quantities of charred fire brands and numberless stone hammers, the latter showing unmistakable evidence of long use.

The best obtainable information leads to the conclusion that the first attempt at copper mining on Isle Royale was made in 1846, at a time when the copper fever was at its height on Keweenaw Point. It appears then to have been a field of considerable activity in the way of exploration, the sub-agents with Foster & Whitney reporting quite a number of explorations as being in progress in 1847–8. As to who were the projectors of the first mining enterprises on Isle Royale our informants differ very materially. Mr. Hill accords the honor to the Pittsburg & Isle Royale Mining Company, while Captain Wm. Tonkin, now agent at the Atlantic mine, near Houghton, says the name of the corporation was the Siscowit Mining Company. On the other hand, I find no mention of either in Foster & Whitney's Report, though it does speak of the Ohio & Isle Royale Mining Company's mine at Rock Harbor. It is, perhaps, simply a confusion of names, and all refer undoubtedly to the same mine as being the scene of the first mining operations on the island.* Both Mr. Hill and Capt. Tonkin agree that the work on what was called the Siscowit mine—most probably the property of the Ohio & Isle Royale Mining Company—was commenced in 1846, on Rock Harbor, about one mile north-east of the main entrance thereto, which is at the south end of Cariboo Island. C. C. Douglas was the first agent, and was succeeded by Bernard Hoopes, of Philadelphia, where I believe, he is still living. A small stamp-mill and a number of good buildings were erected, and mining operations were continued till 1855, when the company became finanically embarrassed and the mine was abandoned. Capt. Tonkin was in charge of the underground work and of the stamp-mill in 1852–3. He tells me that the work was prosecuted on two small veins, the east one of which dipped to the west, the other standing very nearly perpendicular—the one yielding stamp rock, and the other small masses or barrel work. At the time the captain left the mine they were working on the 6th level in the east vein, and were down to the 3d in the other, with every indication that the two would ultimately come together, in which case he thinks it would have been a good paying mine. After he left, his successor, who appears to have been a thorough incompetent, sank 100 feet on the east vein and lost it, which so discouraged the company, already embarrassed, that it concluded to abandon operations—a conclusion which was hastened to a final consummation by the seizure of all its property on the island by virtue of an execution issued in the interest of its creditors. Capt. Tonkin's recollection is that the mine produced during the time it was wrought about 150 tons of ingot.

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*It is probable that some of the companies were afterwards consolidated, since Dr. Jackson speaks of the Siscowit company, Whittlesey, agent, having a location three miles from Gull Rock, which is on the other side of the island, and directly opposite the entrance to Rock Harbor. The apparent contradiction in the recollections of our informants may thus be accounted for.

As showing the difficulties attendant upon the prosecution of a mining enterprise in such an isolated location at that early day—on an island only visited at long intervals by steam or sail craft in the season of navigation, and to and from which there was neither ingress nor egress during the winter months—Capt. Tonkin relates that about Christmas, 1853, the stamp-mill took fire and was entirely destroyed. There was only one horse on the island, and he was lame, halt and blind; a considerable number of men were thrown out of employment, and must necessarily be fed, as there was no possible means of sending them away. They were set to work re-building the mill, the timber for which was all drawn upon the ground by hand, the lumber sawed with whip-saws, of which there were fortunately three on the island, and the new mill was ready for the machinery by the opening of navigation the following spring, and actually in operation by the middle of May.

Ransom & Reynolds in the same year, (1846), opened the Rock Harbor mine, immediately opposite the entrance, and took out some native copper, but the vein was too inconsiderable in size to pay, and it too was abandoned, though not until after considerable money had been sunk.

Dr. Jackson, in his journal of the geographical survey of 1847, after referring to both the properties mentioned above, says that, leaving Rock Harbor, they coasted along the shore towards the eastern extremity of the island, and stopped first at the Union Company's location, "two miles from Rock Harbor." This location was in charge of Mr. Charles Whittlesey, and was then undergoing exploration. Dr. Jackson says there was a vein containing native copper, about five feet wide, running nearly east and west, which would be across the metalliferous bed—to which last no attention appears to have been paid in the earlier stages of copper mining on Lake Superior—the dip being about 82° to the north. Some fine specimens of copper were seen, the native masses being mostly in sheets, and lying in contact with the walls of the vein, which were well defined. Mr. Dickenson, Dr. Jackson's 2d sub-agent, who was sent to examine the island the following year (1848), reports that Whittlesey had sunk a shaft 40 feet, and drifted 90 feet, and claimed he had "40 tons of 25 per cent. ore on hand." He had six or seven men at work when Dickenson arrived, but subsequently all but two had left. The Isle Royale & Ohio Company had a few men employed in sinking a shaft at Datholite, which appears to have been located somewhere on the coast of the island between Chippewa and Rock Harbors, and was so named on account of the prevalence of veins of datholite. A Mr. Mathews, a Cornishman, with a few miners had just arrived, and Mr. Douglas came in the boat in which Dickenson left, "with workmen to finish the construction of the copper furnace"—stamp-mill, he most probably meant, though a furnace may have been attempted prior to the erection of the stamp-mill and the fact escaped the memory of those most familiar with the early history of the island.

At Scoville's Point, near the northeast extremity of the island, a man by the same name was digging copper at the time of Jackson's visit in 1847, but in the following year, only one man was to be found there. About 100 rods south-west of Scoville's pit a man named Shaw had, in 1848, sunk a shaft to a depth of 90 feet, and had found "some rich mixtures of copper and veinstone, but not enough to pay." Duncan's location was on the main island, opposite Scoville's Point, and a man named Mathewson Miller and the American Exploring Company were disputing over the possession of a vein on Amygdaloid Island, which Jackson says was composed of hard epidote, only four inches wide and very poor in copper. Miller also had a location on the main-land, where about 300 pounds of copper had been got out with the pick and gad.

On the north side of Todd's Harbor, the Pittsburgh & Isle Royale Company commenced work in 1846, with H. H. McCulloch as agent and superintendent. They sunk and drifted in a small fissure vein, and drove an adit in from the lake shore, on a vein about three feet wide, from which they took considerable native copper. They had a small stamp-mill, and shipped some copper, mostly native masses, which occurred in the shape of thin sheets. This mine was abandoned in 1850.

Other attempts to open mines were made during the years 1846–8—by the Franklin Company—which had six locations at and around Washington Harbor, by the Isle Royale and Chicago Company at Huganon's Cove, by the Ohio and Dead River Company, on Phelps Island, and others, all of whom failed.

The next venture was by the Island Mining Company, on Siscowit Bay, which commenced work in 1873 in a belt of conglomerate very similar to that of the Calumet & Hecla, and which had previously been discovered by Hon. S. W. Hill. Two shafts were sunk on the slope of the vein or lode to a depth of 200 and 150 feet, respectively. These shafts are 350 feet apart, and connected on two levels, while a third shaft 350 feet further west is down 50 feet in rock, though only a few fathoms of the vein have been stoped away. Some fifteen or twenty good buildings were erected, including a warehouse on the bay shore (two miles and a half distant from the mine), where a large crib dock was put in. The buildings are still in a good state of preservation, but only a part of the dock remains, the outer end having been carried away by a heavy nor'easter. The company, after getting the mine fairly opened, leased it to the Equal Rights Tribute Company, which afterwards changed its name to the Island Tribute Company. The company itself never produced any copper, but the Tribute Company worked the mine during the years 1876–7, and, as we learn from the books at the smelting works, raised 124 tons and 68 pounds of mineral, which yielded 82 tons, 1,994 pounds of ingot. The Tribute Company erected a 40-ton stamp-mill, which is still standing and in good order. Mr. S. E. Cleaves, of Houghton, who was one of the active members of the Island Tribute Company, and under whose direction the mill was built, informs us that the lode is not only rich in copper, but that it is one of goodly size; the only trouble being that the dip is so flat that the rock when blasted down lies where it falls on the foot-wall. It does not appear to have occurred to the tributors that this difficulty might have easily been overcome by means of shifting-tram-ways run diagonally up the foot-wall and connecting the stopes with the skips. Mr. Cleaves is positive in the belief that with a mill capable of treating not less than 100 tons of rock per day the mine could be made to pay handsomely.

The Minong Mine, near McCargoe's Cove, was opened in 1875, by a company of the same name, A. C. Davis, agent and superintendent. The Minong Company owns an estate of about 7,000 acres, purchased from the North American Mineral Land Company, a corporation which still owns a large body of land extending over nearly the whole length of the island, and covering nearly the whole of the mineral belt, aside from the Island and Minong properties. The Minong Company has produced 249 tons, 650 pounds of refined copper, working, as an old copper miner says, with nothing but a pick and brad. I did not visit the mine, the tug which carried me to the island not remaining long enough to permit me to do so, and it is perhaps just as well, since the company was then employing but a few men, and shortly afterwards suspended operations altogether. I learn, however, from those who are well posted, that the operations of the company have been of the most desultory character. Mine work has been principally, if not wholly, confined to "grubbing on the surface" in a search for mass and barrel copper, and it would appear that no real, well-directed effort at legitimate mining has been attempted since Mr. Davis resigned charge of the work, which, I believe, was at the end of the second year. Since then operations have been confined chiefly to digging off the top of the metalliferous bed, very little if any attention being paid to the veins which, though small, are said to be exceedingly rich in copper. The company have a small stamp-mill, about one mile back from the head of the cove, and which is connected with the docks by a railroad one mile in length.

The copper bearing rocks of the island are the same series as those on the south shore of Lake Superior, and consist of alternating Trappean beds—amygdaloids, diorites, conglomerates and altered sandstones—commonly known as the trap range. The island is about forty miles northwesterly from that portion of the trap range known as Keweenaw Point, and the two appear to cover opposite rims, or outcrops, of a great geological basin, the rocks from either dipping under Lake Superior to a synclinal axis. The geological position and lithographical characteristics of the rocks of the two districts are strikingly similar and well-known. There is also a repetition of the same classes and characteristics of veins.

The lines of strike of the rocks on Isle Royale and Point Keweenaw have an observable parallelism. And it is a fact worth stating, as bearing on the future value of the developments that may be made by explorations on the island, that, between a line drawn northwesterly from the most southerly mine on the south side of Portage Lake to the southern extremity of Isle Royale and a parallel line drawn from Copper Harbor to the northern extremity of the island, are included the greatest number of large producing and dividend paying mines on the south shore of the Lake. The mines referred to are the Calumet & Hecla, Quincy, Cliff, Central, Osceola, Pewabic, Franklin, Atlantic, Ossipee and Copper Falls—in the order of the dividends paid by each respectively, the aggregate of which to May 1, 1884, amounted to $34,975,000. The two parallel lines mentioned as touching the two extremities of the island form a parallelogram with the strike of the rocks, but not a rectangle. The two lines have a direction more nearly coincident with the course of the series of geological faults, the occurrence of which gives the noticeable curvilinear shape to Point Keweenaw.

The work of exploration and mining on Isle Royale has been a mere bagatelle compared with the similar work which has been done on the copper range of the south shore of Lake Superior. This fact has been owing, first to the isolation of the island; second to the failure of the early ventures at Rock Harbor and Todd's Harbor, to a want of knowledge of the veins and deposits, and of efficient mining machinery, as well as a lack of capital at that time seeking investment in mining; third, to the fact of the purchase at an early period in the late war, by a few gentlemen, of the large tract of land already referred to as covering nearly the whole of the mineral belt of the island,

and which they have continued to hold ever since to the exclusion of others, who, could they have secured any part of it at government price, might have been inclined to enter upon the work of development.

Copper mining was initiated on Lake Superior in 1845; and, as we have seen, was commenced on Isle Royale the following year, and continued in a small and desultory way until 1854–5. During that time there was a constant and very difficult struggle to secure capital for the development of mines on the south shore of the lake. There was little surplus capital in the country willing to invest in mining. Many mistakes were made in the manner of working the veins, while a constant study of the deposits was going on—a study of which those who understand them now, after the work of the pioneers has fully developed their characteristics, can have but little realization. Then again was the wrestling of years with the machinery for stamping and dressing. The masses and barrel work could be handled, but the stamp work was a record of many failures. It had settled into a belief that stamp veins alone could not be made to pay, and the owners and operators of mass veins sneered at the persistent attempts going on at Portage Lake. Had the great Calumet & Hecla lode (strictly a stamp deposit) been discovered during the first twelve years of mining, it would have been a failure. And on the other hand, some of the mines that have been failures would have been successes had their discovery been as late as that of the Calumet & Hecla. No discovery was more opportune than that of the Calumet & Hecla. It came on the heels of perfected stamping and dressing machinery, when accumulated capital was seeking investment, and had the courage to open the mine as it ought to be opened, and to erect the necessary expensive plant—and also at the time of the working out and decline of the great mass mines, Cliff and Minesota—and for the second time the copper mining interests of Lake Superior were saved—the first event of the kind being the discovery of the once celebrated Cliff in the fall of 1845.

Of the future of Isle Royale as a copper-producing district, many of the oldest and best informed copper miners do not hesitate in the decided expression of opinions most favorable. One gentleman, who has, perhaps, given more intelligent thought and study to the copper-bearing formations of the upper peninsula than any other man now living, has declared to me the opinion that, with the judicious expenditure of a mere fraction of the capital employed in copper mining on the main shore, Isle Royale can be developed into one of the richest mining districts of the world. He argues, first, that the ancient miners knew where copper was to be found in the greatest abundance near the surface; that the ancient pits on Isle

Royale, far outnumbering those which have been found on the main shore, show very conclusively that the island was their favorite and most productive field of operations—that finding there the copper not only in the greatest abundance, but more easily procured than elsewhere, they mined it out to as great a depth as they were able to go with their rude implements, leaving just as rich ground, which still awaits only the application of capital and labor properly directed, for the development of not one but many profitable mines.

Isle Royale has never had a fair show. The only approach to anything like an attempt at legitimate mining, was at the Island mine, where, as has been stated, the greatest depth reached was 200 feet, in a lode very similar to the Calumet & Hecla, and asserted to be equally as rich in copper as the latter was at the same depth—an assertion, however, which may be taken with a large grain of allowance; a second Calumet & Hecla is not likely to be realized in this or any other country, in the near future. But as to the Island mine, certain it is that the lode carries sufficient copper to warrant the expectation of a paying mine should it at any time in the future fall into the hands of parties having the capital and staying qualities which have characterized the work of development on the main-land, having regard to successful mines which in the beginning were far less promising than the Island. When a well-defined, well-directed, persistent effort at development on Isle Royale shall have met with a failure, then, and not till then, will it be proper to doubt the assertion made to me by a gentleman of large experience in copper mining, and who has given much time to geological research on the island, that "there are those now among us who will live to see Isle Royale one of the richest mining counties in America."

KEWEENAW COUNTY MINES.

CONGLOMERATE MINING CO.

At the time of the last report on this property, considerable work had been done in opening up the lode, and much new machinery was in operation; but the principal work then on hand was the erection of the plant to operate the mine on a large scale. As many of the improvements then in process of construction were merely alluded to, I will briefly describe them as completed. The subjoined statistics are for the year 1883, and do not give a fair idea of the property, as the mine was then using the old machinery and mill of the Northwest Mine. The compressor plant was in, however, and the figures given show the cost of operating it.

During the year 1883, most of the work done was merely exploratory, and consisted in sinking and drifting on the Allouez conglomerate, this being the lode selected to work upon.

No. 1 shaft, which is the most westerly, or rather that one on the lode nearest to Portage Lake, was sunk from the 4th level to a short distance below the 8th. No. 2 shaft was sunk from a point below the 5th level to a short distance below the 8th. No. 3 shaft was also sunk to a depth below the 4th level. An upraise was made from the 4th level at a point about 250 feet east of No. 2 shaft to the third, and a winze was sunk from the 4th to the 5th between shafts No. 2 and No. 3, at a point midway between them. The above comprises all the sinking and raising done.

The drifting done was as follows: West of No. 1 shaft the 3d level was driven 120 feet, the 4th level 150 feet, the 5th level 300 feet, the 6th level 160 feet, the 7th level 25 feet and the 8th level 35 feet. East of No. 1 shaft the 4th level was driven 300 feet, where it broke into the level running west from No. 2. The 5th level was driven 500 feet to where it met the level west from No. 2 shaft. The 6th level was driven 215 feet, the 7th level 85 and the 8th, 90 feet. West of No. 2 shaft the 6th level was driven 495 feet, but the level was not broken through till the early part of 1884. The 7th level was driven 240 feet and the 8th about 25 feet. East of No. 2 shaft the 4th level was driven to a distance of 580 feet from the shaft, and the 5th level extended 450 feet, leaving the heading about the same distance east as on the 4th level. The 6th level was driven 300 feet, the 7th 175 feet and the 8th 120 feet. At No.

3 shaft the only drifting done was about 120 feet west on the 4th level.

The total amount of rock broken in the drifts, winzes, shafts, upraises and stopes, was 73,351 tons, at a total cost of $116,084.80, making the cost per ton $1.58.

The total compressor cost was $10,080.67, making the cost per ton of rock broken $.137.

The pumping cost was $.0341 per ton of rock broken. Of the amount of rock broken only 20,295 tons were stamped at the mill. The stamping was done at the old Northwest Mill for eight months. In October, the new mill at Lac La Belle was completed, and during November and December the rock was stamped there.

The new engine house is located on the hanging-wall side of the lode, between shafts Nos. 1 and 2, and about north of the rock house. The hoisting ropes run along the hanging side parallel to the outcrop, and at each shaft pass around a sheave at an angle of 90° to the top of the shaft house, where they pass over a second sheave at quite an acute angle, and thence down the shaft. The hoisting machinery consists of two Corliss engines, 24x48, which are connected to a pinion shaft. This shaft carries two pinions 4 feet in diameter, each one of which meshes with two 14½ feet gears. These gears are attached to four 14-foot drums by means of the Lane Band Friction. The engines make 50 revolutions per minute, with a constant boiler pressure of 65 lbs. The speed of hoisting is 600 feet per minute, and the skips are lowered at a rate of 2,200 feet per minute. Three drums are now in place, but only two are being used for hoisting through shafts 1 and 2. Only one engine of the pair is being used, it being sufficiently strong to operate the whole four drums for a time in case one engine should be laid up for repairs. The engines were built by Watts, Campbell & Co., of Newark, N. J.; the hoisting machinery by the Webster, Camp & Lane Machine Co., Akron, Ohio. The plant is capable of hoisting from a depth of 2,500 feet.

The Lac La Belle & Calumet R. R. has been completed from the mill to the mine. Its equipment consists of two eight-wheeled locomotives, built by the Baldwin Co.; 24 rock cars, Gondola pattern; six platform cars and two box cars.

The new mill at Lac La Belle has been completed, and has been in operation since November 1st, 1883. The stamping plant consists of three all-iron Ball-heads. The diameter of the cylinders is 16 inches, stroke 24 inches, counter bore 16¼ inches. Davidson pumps are used to produce a vacuum.

The wash or concentrating plant was manufactured by S. E. Cleaves & Son, of Houghton, Mich., and consists of 84 Collum washers, with Cleaves' iron bodies, 8 Coggin separators and 8

Evans slime tables. There are 28 washers to each head. Of these the upper 16 make 125 strokes per minute, and the lower 12 130 strokes per minute. Six of the Evans slime tables treat the slimes as they come from the separators, and the other two tables finish their products. The machinery is driven by a 20x48 Corliss engine, the steam pressure being 100 lbs, and the engine making 64 revolutions a minute.

The water for the mill is furnished by two Davidson compound tandem pumps. High pressure cylinder, 14x24, low pressure, 24x24, water cylinder, 24x24. The lift is 13 feet, and the total height to which the water is raised is 53 feet. One Davidson pump is kept for fire purposes. Its dimensions are: pump cylinder 12x24, steam end 20x24.

Two heads of stamps are now running, each stamping about 6,000 tons of rock a month. Each head has two feeders per day—one each shift. The hard iron is furnished by Cleaves & Son, with the following result for wear:

Shoe	7	days.
Stave linings	4	months.
Rings	8	"
Die	4	"
Side linings	10	"
Hopper linings	12	"
Inside grate frames	6	"
Outside "	12	"

The steel grates last about 3 to 4 weeks.

The old Pennsylvania dock at Lac La Belle has been rebuilt and enlarged. The dock has a front of 204 feet, is 50 feet wide, and upon it has been built a warehouse 25x50. The canal between Lac La Belle and Lake Superior has been cleaned out, and boats drawing 12 feet of water can now enter.

The mill is lighted by 70 Edison incandescent lamps. The dynamo used is T No. 9. Considerable difficulty was at first experienced by the constant breaking of the carbon horseshoes, because of the vibration to which they were subjected, but this has been remedied by setting the lamps on springs.

The following is a summary of the cost of the principal items of equipment of the plant:

Calumet & Lac La Belle R. R.	$145,000
Lac La Belle Stamp Mill	175,000
Hoisting Plant	70,000
Compressor Plant	60,000

Although properly belonging to my next report, the following figures are given as showing the present cost of operating the mine. These figures are from the cost sheet for the month of September, 1884, and the calculations are based on the rock actually stamped:

Breaking rock per ton stamped	$.562
Passing rock	.113
Tramming rock	.112
Compresser cost	.043
Pumping cost	.006
Hoisting cost	.072
Trestle transportation to rock house	.050
Rock house	.111
Lac La Belle & Calumet R. R.	.056
Stamp Mill	.434
Surface	.038
Office and general expense	.054
Total cost per ton rock stamped	$1.651

There was stamped during the month 12,024 tons.

COST SHEET FOR 1883.

Departments.

Mine cost — contracts	$ 75,447 16
Mine cost — time roll	37,861 37
Mine cost — summary, machinists, etc.	2,776 27
Compressor	10,080 67
Pumping	2,522 63
Hoisting	13,925 69
Rock House	8,448 83
Locomotive	2,465 48
Shaft Houses	2,913 20
Stamp Mill	21,098 05
Surface	6,522 75
Office and general expense	11,843 28
Mine Plant	1,211 18
Permanent Supplies	15 26
Exploration	199 26
Railroad Operation (Dec. only)	1,008 84
Total	198,339 92

Construction.

Lac La Belle & Calumet R. R.	136,670 86
" " " improvements	7,420 87
New Stamp Mill	81,913 18
New Hoisting Plant	44,411 41
Lac La Belle Canal	17,841 67
Total	288,257 99
Grand total expenditure 1883	486,597 91
Less credit accounts	34,590 76
Net cost for 1883	$452,007 15

MINE COST SUMMARY.

Mine cost — contracts	$ 75,447 16
Mine cost — time rolls	37,861 37
Machinists, 567¾ days	1,548 67
Blacksmiths, 134¼ days	326 15
Foundry bills	394 27
Supplies	507 18
Total Mine Cost	116,084 80
Cost per ton of rock broken	1 58

Tons of rock broken, stopes	25,327.79
“ “ “ openings	48,023.49
“ “ “ total	73,351.28
“ “ hoisted from stopes	25,947.51
“ “ “ “ openings	48,023.49
Total	73,971

Cost per ton.

Breaking	1.02
Handling in stopes	.076
Tramming	.114

Average wages.

Contract miners, per month	$53 66
Company “ “	41 49
Underground laborers, per month	39 62

TREASURER'S REPORT FOR THE YEAR 1883.

Receipts.

Balance December 31, 1882		$13,444 66
Intallments on capital stock	$381,073 00	
Loans	159,098 79	
Interest	3,556 91	
Sales of Copper	46,582 35	
Bills Receivable	9,914 00	
Rent	150 00	
Silver sold	362 55	
Advances to make installment stock full paid,	380 00	
Sundry credits to mine agent	684 11	
		601,801 71
		$615,246 37

Payments.

Mine agent's drafts	314,369 88	
Bills paid at Philadelphia office	140,766 91	
Loans returned	99,486 59	
Bills receivable	9,314 00	
Rent	615 00	
Salaries, Philadelphia	5,950 00	
Expense	4,996 40	
Insurance	4,504 41	
Interest	3,189 81	
Lac La Belle Smelting Co	3,495 00	
St. Mary's Canal M. Land Co	10,046 80	
Capital invested in State of Pennsylvania	543 57	
Expense account, copper smelting, etc	7,069 20	
Balance December 31st, 1883	10,898 80	
		$615,246 37

GEO. H. LEWARS,
Assistant Treasurer.

Assets and liabilities of the Conglomerate Mining Company, Dec. 31st, 1883, apart from Mines and Mining Plant:

Assets.

Cash	$10,898 80	
Installments due	49,346 00	
Sundry debits	87 50	$60,332 30
Copper in hands of N. Trotter & Co. (proceeds since received)	6,077 37	
Copper at mine—estimated at 129,930 lbs., at 9 cents per lb	11,693 70	17,771 07
Assets at Mine available against cost sheets.		
Cash	970 57	
Mining supplies	32,382 13	
Merchandise, provisions, etc	37,186 69	
Wood	16,743 47	
Team account	1,323 70	
Accounts receivable	7,515 09	96,121 65
Amount subject to future calls to pay up installment on stock		100,000 00
		$274,255 02

Liabilities.

Agents' drafts outstanding	33,850 21	
Indebtedness at mine	18,105 66	
Accounts payable at Philadelphia office	77,859 44	
Loan account	40,000 00	169,815 31
Balance of assets		$104,409 71

CENTRAL MINE.

Nearly all the work during the past year has been south of No. 2 shaft, although some was done on the conglomerate. The vein (a fissure) in this mine, dips slightly to the east, which at the bottom of the 250th level throws it 180 feet away to the east of the vertical shaft. The man engine shaft with the engine is down to the 210th, and follows the dip of the vein.

No. 2 shaft, which is the only one through which rock is hoisted, is perpendicular, and from it cross-cuts are made on the various levels to the vein. The method of opening up is by sinking a winze from the lowest level to the depth of the proposed new level, and then drifting along the vein to determine its value. If found rich enough to stope, and this has always been the case, the main shaft is then sunk and a cross-cut made to connect with the bottom of the winze.

At the time of my visit the winze and the shaft from the 240th to the 250th had been sunk, and the level holed through, and men were just blasting away a suitable chamber near the foot of the shaft to accommodate the fork for the pump. The skip road was only down to the 240th, and the hoisting from the shaft and the winze was being done by small engines, driven by compressed air.

The 240 fm. level had been driven both north and south, but to the north nothing but barren ground had been encountered. The south drift has struck the top of an amygdaloid, but it showed no copper.

The bottom of the 250th seemed in good ground, and on the 240th one large mass had been encountered and was being cut up. Taking everything into consideration the mine looks well, —better, in fact, than it has for years.

When the mine was first wrought the copper all ran toward the north, and therefore No. 1 shaft was abandoned and an incline sunk in the direction of the chute. At about the 100 fm. level the copper began to grow less toward the north, and from the 190th down little or no good ground has been found north of No. 4.

The chute is now running towards the south, and more and more tramming is made necessary at each successive lift to reach the now only available shaft, No. 2. As the depth increases, either No. 1 shaft will have to be deepened, or the capacity of No. 2 increased by means of two counterbalanced skips, cages or buckets. At present, the hoisting is done in a single skip, and the necessity of using the same skip for timber, often puts the work behind.

In the agent's report, will be found mention of additions to plant during 1883. Since then they have put in a belly-helve hammer made by the Cuyahoga works, of Cleveland, for the purpose of treating the small masses; this it does very effectively and cheaply. The former method of operation was to pick the pieces as clean as possible, then heat them almost red hot by a wood fire, when they were quenched with water. By this means the veinstuff was calcined and disintegrated, and that which did not fall away was rendered friable and easy of removal with the pick.

The mine produced in 1883, 911 tons, 710 lbs. of mineral, or about 1,268,556 lbs. of ingot copper, from 2,557 cubic fathoms of ground. The rock yielded in ingot $1\frac{9}{10}$ per cent.

ANNUAL REPORT OF THE CENTRAL MINING COMPANY.

The directors present the following statement of operations during the year 1883.

The production of mineral was $911\frac{710}{2000}$ tons, and the quantity smelted was $918\frac{075}{2000}$ tons, which yielded about 69 per cent., or 1,268,556 pounds of refined copper.

The following is a summary of the year's business :

PRODUCTION.

Copper sold...............700,858 lbs. at $15\frac{12}{100}$ cents.......		$105,965 02
Copper on hand, sold......425,052 lbs. at 15 cents..........		63,887 80
Copper on hand, unsold....142,646 lbs. valued at $14\frac{1}{2}$ cents..		20,683 67
1,268,556 average 15 cents.		$190,536 49
Silver..		1,023 17
		$191,559 66
Mineral at mine, Dec. 31, 1882, as per last report, valued at....................................	$12,834 50	
Mineral at mine, Dec. 31, 1883, $57\frac{980}{2000}$ tons, valued at..	9,198 40	
Decrease in value of mineral at mine....................		3,636 10
Net value of product of 1883..........................		$187,923 56
Add interest received....................................		7,751 73
		$195,675 29

COSTS.

Working expenses at mine......................	$158,274 23	
Smelting, freight and all other expenses..........	31,451 12	
Net operating expenses..................................		189,725 35
Showing a profit of..		$5,949 94
There has also been received an account of sale of timber...		30,000 00
Making an increase of available assets of...............		$ 35,949 94
The surplus from 1882, after disposal of copper on hand and payment of dividend, was......................................		214,192 67
Making the net surplus, Dec. 31st, 1883.................		$250,142 61

as shown in detail in the annexed statement of assets and liabilities, and from which a dividend of $2.00 per share ($40,000) was paid to stockholders February 1st, 1884.

The product of the mine, and the expenditure incurred, have varied but slightly from the figures of the previous year, but the large decline in the market value of copper has reduced the receipts to such an extent as to leave but little profit on the year's business.

The vein has continued to be of small size, and the productive portion of it limited in extent. The improvement which has been expected for two years past did not appear in 1883; within a few weeks, however, the drift in the 23d level, at the farthest point south yet reached in the mine, has opened a larger yet more promising vein, and if this improvement should continue, and extend to the levels above and below, an important increase of production may be looked for when this ground is reached by those levels.

We have received during the year a further payment of $30,000 on account of sale of pine timber reported last year, which has enabled us to make the yearly dividend above named.

For more detailed information we refer to the agent's report and financial statements herewith submitted.

Geo. A. Hoyt,
Wm. C. Sturges,
Rob't Porterfield,
Albert J. Hatch,
John J. Crane,
Jordan L. Mott,
Directors.

Assets and Liabilities, Central Mining Company, Exclusive of Real Estate and Mine Plant.

ASSETS.

Cash		$56,289 11
Loans		20,000 00
Silver on hand		1,023 17
Copper on hand (sold) 425,052 lbs		63,887 80
Copper on hand (unsold) 142,646 lbs., valued at $14\frac{1}{2}$ cents		20,683 67
Accounts receivable		273 99
		$162,157 74

At Mine.

$57\frac{980}{2000}$ tons mineral, at $160	$9,198 40	
Cash	4,561 62	
Merchandise in store	31,739 66	
Supplies	65,112 48	
		110,612 16
		$272,769 90

LIABILITIES.

Agent's drafts	$ 4,448 58	
Indebtedness at mine	13,273 20	
Accounts payable	4,905 51	
		22,627 29
		$250,142 61

Less dividend, February 1, 1884, of $40,000.

BALANCE-SHEET, CENTRAL MINING COMPANY, DECEMBER 31, 1883.

General expenditure to December 31st, 1882		$5,589,562 33

EXPENDITURE IN 1883.

Central mine	$163,914 98	
Freight	7,944 16	
Smelting	16,439 78	
Insurance	759 92	
Brokerage	926 93	
Expenses	5,380 33	
		195,366 10
Dock and warehouse		9,112 07
Dividends		1,670,000 00
Cash		56,289 11
Loans on call		20,000 00
Copper on hand		84,571 47
Silver on hand		1.023 17
Accounts receivable		273 99
		$7,626,198 24

Capital advanced by stockholders		$100,000 00

REAL ESTATE.

Sale of timber	$70,000 00	
Less cost of real estate	20,988 25	
		49,011 75

SALES OF COPPER.

Sales previous to 1883	$7,272,969 59	
Sales in 1883	190,536 49	
Silver in 1883	1,023 17	
		7,464,529 25
Interest received in 1883		7,751 73
Accounts payable		4,905 51
		$7,626,198 24

AGENT'S REPORT.

JOHN STANTON, Esq.,
Secretary and Treasurer, New York:

DEAR SIR—The following report of operations at our mine during the year 1883 is respectfully submitted:

GROUND BROKEN.

Sinking in shafts and winzes, $200\frac{8}{12}$ feet, average cost	$26 39
Drifting on the vein, $1,199\frac{1}{12}$ feet, average cost	9 23
Drifting on the conglomerate, $91\frac{8}{12}$ feet, average cost	11 61
Stoping on the vein, $1,691\frac{25}{36}$ sup. fathoms, average cost	14 82
Stoping on the vein, $21\frac{132}{216}$ cubic fathoms, average cost	23 61
Stoping on the conglomerate, $137\frac{22}{36}$ superficial fathoms, av. cost	23 56
Sinking on the conglomerate, $379\frac{9}{12}$ feet, average cost	13 75

The total amount of ground broken in openings and stopes is 2,557 cubic fathoms.

PRODUCTION.

760 bbls. stamp copper, weighing	999,445 lbs.
164 hhds. kiln copper, weighing	520,595 "
152 masses copper, weighing	302,670 "
Total	1,822,710 lbs.

Or $911\frac{710}{2000}$ tons.

Average yield of mineral per fathom of ground broken	712 lbs.
Average yield of ingot per fathom of ground broken	496 "

STAMP MILL.

The expenses at the mill were as follows:

Labor	$7,382 39
1,651 cords wood consumed	5,365 75
Lights, oils, shovels, etc	336 26
Repairs, materials, fixtures, etc	950 67
Lumber, freight, and teaming	58 24
	$14,093 31

Tons of rock stamped	18,146.
Yield of rock in mineral	$2\frac{75}{100}$ per cent.
Yield of rock in ingot	$1\frac{9}{10}$ per cent.
Cost of stamping and washing per ton	$77\frac{66}{100}$ cents.
Running time of 24 heads	$151\frac{77}{96}$ days.
Rock stamped per head, 24 hours running time	$4\frac{9}{10}$ tons.
Rock stamped and washed per cord of wood consumed	11 tons.
Cost per ton of breaking and selecting rock and tramming to mill	$11\frac{17}{100}$ cents.

During the past year two batteries of stamps have been reset and two slime tables added; other minor improvements have been made in the mill as required. We are now preparing to add six Collum washing machines to the mill plant, which I think will result in a saving of copper.

SINKING.

No. 2 shaft has been sunk from the 23d to the 24th level. A winze has also been sunk from the 23d to the 24th level. The vein in this winze has varied from one to three feet in thickness, showing a lode of medium quality of stamp rock.

The inclined shaft on the conglomerate has been continued 379 feet. This belt has ranged from two to three feet in thickness, and in a few places has been very poor. It is now fully three feet thick, and produces rich stamp rock, but, as heretofore, is only productive for a length of 20 to 30 feet where crossed by the vein. This inclined shaft is 525 feet below the 21st level, and is becoming more and more expensive to operate as the rock must be hoisted to the 21st level by compressed air and trammed to No. 4 shaft before it can be directly raised to the surface; but if it continues to produce copper as at present, it will pay well to work for some time yet.

We are sinking a winze on the vein opposite No. 2 shaft, and it is now 39 feet below the 24th level. At the top of the winze the vein was only one foot thick, but at the bottom it is from 2 to $2\frac{1}{2}$ feet thick, showing good stamp and some barrel work.

DRIFTING.

We have driven a cross-cut at the 24th level from No. 2 shaft east 185 feet 10 inches, to intersect the vein. We have also cross-cut at different points on the conglomerate, in all 92 feet. The 21st level, south of No. 2 shaft, has been extended 32 feet, in a poor vein throughout.

The 22d level, south of No. 2 shaft, has been extended $297\frac{9}{12}$ feet, and is now $564\frac{9}{12}$ feet south of the shaft. The vein in this drift has been very changeable, sometimes widening to 4 or 5 feet, and then contracting to a few inches only. The greater part of it has, however, opened a good stamp lode of about $1\frac{1}{2}$ feet in thickness.

The 23d level has been driven north of No. 2 shaft $15\frac{1}{2}$ feet, and has been very poor. This level has also been driven south of No. 2 shaft $301\frac{2}{12}$ feet, opening a vein which has varied greatly in size and richness, but on the whole it has shown quite an improvement over the level directly above. The greater portion of the distance opened has shown a vein of good stamp rock.

The 24th level has been driven north of No. 2 shaft $160\frac{8}{12}$ feet, and south of same $118\frac{1}{12}$ feet, through barren ground. Inasmuch as we are getting in the line of the "shoot" of copper in the levels above, I am of the opinion that we shall soon strike copper bearing ground in this level.

STOPING.

The major portion of our copper during the past year has come from the back of the 23d level, south of No. 2 shaft. The stopes here are still producing good stamp and barrel copper. In one of them we are now cutting a mass which exposes to view from 15 to 20 tons. From this mass 20 tons have already been cut. The stope is now nearly up to the bottom of the level above, therefore we cannot expect much more copper from it.

The stopes in the backs of the 20th and 21st levels have produced a limited quantity of stamp rock, the vein having been comparatively thin and poor.

Very little stoping has thus far been done in the back of the 24th level—not enough to enable me to form an opinion as to its prospective yield.

MACHINERY, ETC.

A pump and skip road have been placed in No. 2 shaft from the 23d to the 24th levels. New fire fronts have been placed at the boilers of the No. 2 engines, and at the stamp-mill. With the exceptions of the foundations of the boilers at stamp mill—which will need re-setting during the coming summer—the machinery on the surface and underground is in good condition, and performs its work satisfactorily.

A new mine office has been constructed out of a house heretofore used as a dwelling (at a cost of $400) and considerable work has been done during the year in repairs to the dwelling houses on the mine.

The general appearance of the mine is about the same as it was a year ago.

Yours respectfully,
JAMES DUNSTAN, *Agent.*

CLIFF MINE.

At the Cliff no work is being done on the old vein. The pump having been stopped July 1st, 1883, 13,383 lbs. of mineral and mass having been produced subsequent to January 1st of that year.

A little drifting has been done on the ninth amygdaloid floor, to the east and west; but they have not shown up very much in the belt. They cut in these drifts two or three other fissures, but they were quite barren.

Work on the new vein has been continued through the two shafts mentioned in last report; one of these shafts is in Sec. 31, T. 58 N., R. 31 W., and the other Sec. 1, T. 57 N., R. 31 W. From one of these shafts they drifted about 15 or 20 feet on the vein, which though rich, is only about 6 inches wide.

Last summer, 1884, they sunk two shafts on what is supposed to be the same vein in Sec. 25, T. 58 N., R. 32 W. The south one of the shafts was drifted from towards the lake shore, and the southern one towards the ash bed on which the Copper Falls is working. The good showing made by the Copper Falls, and the success of the Atlantic in working a low-grade ash bed has stimulated similar attempts elsewhere.

The Cliff management is determined to explore their property thoroughly, and have discovered and opened upon at least fourteen different veins. This is all the work that has been done by the Cliff Company, and there only remains to speak of the enterprise now under way of treating the old stamp-mill sands. These sands were deposited years ago from the mill, when copper was plenty, and all the milling work was stamped coarse and not washed carefully. It was wheeled out of the mill in cars and dumped in piles from the trestle, where the different layers can be seen and recognized by the color and size of the grains.

Last March a company was formed, known as the Hodge Association, to work over these sands, and they have erected a small plant capable of treating 150 tons a day. They find that the most paying parts of the sand heaps are those made from the rock which had been subjected to the action of fire in kilns during the old Cliff Company's regime. The mill is situated close to the county road, and the sand is hoisted from the piles over an incline, trestle to the top, in cars holding two tons each. Here at the top are bins of 100 tons capacity. The process of treating these sands is as follows:

1. From the bins the sand is fed to two pair of chilled cast iron rolls 12x12, by which it is crushed to a moderate degree of fineness.

2. It then passes over four sieves of washers, and the coarse copper is taken out by skimming the beds. This copper is dark green, as it has been exposed to the atmosphere for many years, by which it has been oxidized, and the surface converted into carbonate.

3. The sand from the aprons of these sieves is run with the wash water over a series of horizontal brass wire grates, by which all the fine material is sifted, and that with the hutchwork from the four jigs goes off and will be followed further along in the 5th paragraph.

4. The coarse sands from 3 are now fed into five Hodge grinders, and there reduced to the last state of fineness. The Hodge grinder consists of two closely fitting cones, one over the other, and between the two surfaces the sand passes while the outside cone revolves. By this means the sand is ground, and the copper instead of being beaten out into float is rolled up into cylinders or spheres, the most perfect form for jigging.

5. From the grinder the product together with the fine material from 3 is passed through fine hydraulic separators, one for each grinder. These separators make but two classes; first, the sand which is treated in 6, and second, the slimes which go to waste.

6. From the separators the sands go over ten sieves of washers. The sand passing over the aprons goes to waste, and the hutchwork goes to

7. Five finishing washers. The hutchwork from these ma-

chines is fed back over and over again, and the sands go to waste.

The copper saved in these last fifteen sieves is all obtained by skimming, the hutchwork not being pure. At one time they treated all the slimes on tables, but after getting several barrels of mineral, they discovered it to be about ten per cent. of copper and fifty per cent. of *metallic iron.* Such a product was not appreciated, and the tables were abandoned.

This process has not been in use long enough to enable me to give any accurate data as to practical results. I understand, however, that treating 150 tons a day they get about 3 bbls. of mineral a week, and use 3 cords of wood a day. They employ for 24 hours 3 men and 8 boys.

ST. CLAIR MINE.

Not much advance was made in this mine during the year 1883. The 50 level was drifted towards the greenstone a distance of 198.4 feet, but no sinking was done. There was stoped 306.2 superficial fathoms of ground, which yielded 159,950 pounds of mineral, which in turn gave 125,225 pounds of ingot, at a total cost of $25,943.91. No additions have been made to the plant, and the mine is in nearly the same condition as at date of the last report. The appended table shows the cost in partial detail.

The rock is crushed by a single battery of pneumatic stamps, which are fed automatically from the rock bin. The sands are ground in a Hodge grinder, and the slimes are treated on a concave instead of an Evans table. This concave table gives clean heads, but loses considerable copper. In many of the German dressing works they are used in connection with the convex table, and give most excellent results.

COST SHEET ST. CLAIR MINE, 1883.

Mining expense	$15,333 91
Hoisting "	2,669 79
Rock-house "	289 30
Stamp-mill "	2,092 58
General "	1,794 10
Freight and charges	442 23
Ingot barrel expense	60 15
Interest account	1,666 04
Smelting account	1,393 87
Commission account	191 88
Marine insurance	10 06
	$25,943 91

Mineral produced	159,900 pounds
Ingot	125,225 pounds
Cost per pound of ingot	12¾ cents

COPPER FALLS.

Up to about the 1st of July, 1884, the Copper Falls was under construction work, and although the mine is an old one, it is now only fairly under way in operating the ash bed. The statistics as given are for the fiscal year ending June 30th, 1884, and show a cost of about $2.02 per ton of rock stamped. This of itself is a good showing, but the management considers it high, basing the statement upon the fact that during the year the mine was not in a condition to treat the rock as economically as it will hereafter be. The stamp-mill was not run to its full capacity, and considerable work was done and money spent in relaying the adit level track. In the mine the levels were opened up ahead, so that there were enough points of attack exposed to allow tbe drifts and stoping to be done by day shift alone—Mr. Emerson being much in favor of this plan of working day shift only whenever the circumstances will allow. The increase of plant is the only objection, and in this mine, where there is no pumping and practically no hoisting to be done, the only increase is in that of the compressor. The advantages gained are chiefly in the matter of labor. Miners never go to work Saturday evening, so that they get only five shifts a week out of the contract men when on night shift. Yet, although they do less work in the month to the extent of four shifts, they want the same pay, as they all calculate to make just so much a month. Thus, for example, if you have four men on a stoping contract—two by day and two by night—you get out of four men twice twenty-six, or fifty-two, day shifts, but only twice twenty-two, or forty-four, night shifts. If you now have twice as many openings, and can give each party of two a stope and work the day shift only, you get twenty-six shifts per man per month. In addition to this it is found that two men working together accomplish more, as they have no fear of doing more than their partners—a great trouble when four men work in two parties. The mine is now opened up to the 60 above the 90 level (which last is the adit level), and down to the 120. The drift stopes are all advanced as far as what is known as No. 3 fault; here they are cross-cutting on one level only, to get the vein again. The sinking the last fiscal year amounted to 51.5 feet, mostly in opening up the 120 level and in preparing the second hoisting incline. The drifting covers 386 feet, all of which was in the inclined cross-cuts at the various faults. In the drift stopes they have in the same time broken 1440.78 fathoms, which includes 24 fathoms on the Owl Creek vein. In the regular stopes, 1345.75 fathoms were removed. The excess of drift stoping over regular stoping shows the manner in which the mine was opened up. The fathoms given are in fact superficial, as they open about seven feet high and pay for only a certain amount, whether the stope be really six or eight feet. They have drifted along the foot 544 feet on the 80 fathom level, and 462 feet on the 90.

In order to minimize and equalize the cost of underground hoisting, it is the aim to keep the work above and below the 90 level, which is on the same level as the adit, about equally advanced. An inclined way runs from the 60 to the 90, and from the 90 to the 120. Just above the 90 level is placed a small double-drum hoister. Now, when the mule train comes in from the mill to the depot at the 90, one car is attached to the rope leading to the down incline and another car is attached to the other rope, which passes from the hoister to the top of the upper incline, where it passes over a pulley and then goes down the incline to the 90 level. The small hoister is now put in motion, and one car goes down to the 120 and the other up to the 60. The cars balance each other, and the engine has simply to overcome the friction and the difference in the weight of the ropes. The hoisting is conducted on precisely the same method. It often happens that owing to circumstances, one car is not ready, or that odd, unmatched levels are being operated; when this is the case, more power is used of necessity. They now have on the location a second double underground hoister which will soon be placed near fault No. 2.

The steam for these hoisters is carried underground in a 3 in. pipe, carefully covered with lagging; the exhaust is carried to the surface in a 6 in. pipe, and the back pressure is found to be very trifling.

They now operate fourteen power drills a day, and tram 110 cars which carry about 275 tons per 24 hours to the mill. The tramming is all done by day, the bins being of sufficient capacity to supply the mill one night.

The rock house is immediately between the end of the adit and the bins. The cars are hoisted on either of two tracks to the right or left hand side of the rock house, and are there automatically dumped on screens, the larger pieces passing into the rock breakers and falling into the bins below. It will thus be seen that the rock is handled but once, from the time it is put into the cars in the mine till it reaches the stamps.

They are now experimenting in the use of the old slot grate and find great advantage in its use by punching the holes very close together and thus increasing the discharge surface. The sands as they run from the waste launder out in the lake assay two-hundreths of one per cent, a good showing.

The present cost of handling the rock is from $1.50 to $1.53 per ton stamped, employing a force of 159 men.

The improvements made since the last report are quite extensive. At the mill fourteen new Collum washers, one Evans slime table, and two Coggin separators have been placed in a "lean-to" on the north side of the mill, built for that purpose. A settling tank, devised by the master mechanic, Mr. S. H. Holley, with a pump to elevate the surplus water back to the heads, is still another improvement.

At the mine they have relaid the adit track with heavy steel rails, and are contemplating using a small locomotive to transport the rock from the underground depot to the rock-house. A new compressor, built by the Ingersoll Drill Co., has been set up on top of the hill. It is an upright, with one cylinder 20x24, and two air cylinders 26x22. The air pressure maintained is 60 lbs., and the steam 65 lbs.; with 50 revolutions a minute they keep 14 power drills in operation. The air was formerly carried under to the drills by a four inch pipe, which is retained, and now supplemented by another two inches larger.

RECAPITULATION JUNE 30. 1884, YEAR ENDING.

Mining Expense	$77,356 40
Main Adit Tramming	4,496 19
Rock House	4,318 58
Stamp Mill	26,645 34
Mineral Expense	1,032 67
Office "	751 25
Surface "	2,898 94
Teaming "	564 50
Miscellaneous "	266 29
Insurance and Taxes	2,088 00
Less credits (rents less house repairs), makes	2,373 75
Total operating expense	$118,044 41
Construction account	18,978 92
Total expenditure for fiscal year	$137,023 33

Mining Expense—Recapitulation.

Mining proper, including captains, timbermen and passing rock, tramming filling and company account men	29,219 58
Rock drills including drifting, stoping and compressor cost	56,245 01
Delivering rock to main adit	3,364 53
Total cost	$88,929 12
Credit by profit on Miners' Supplies	11,572 72
Net Expense	$77,356 40
Sinking per foot ashbed	9 94
Drifting " " "	9 30
Stoping " fathom "	12 48

Main Adit Tramway Expense.

Teamsters, laborers and track-layers	$2,311 48
Blacksmith, machinist, etc., labor	694 89
Supplies	1,489 82
Total	$4,496 19

Amount of rock passed over road, 58,450 tons.

Rock-House Expense.

Superintendence and labor	$1,899 71
Repairs, labor on	213 49
Fuel	2,053 65
Supplies	151 73
Total	4,318 58

Rock treated, 58,450 tons.
Average per day, $62\frac{2}{3}$.

Stamp-Mill Expense.

Superintendence and labor	$10,323 01
Labor on repairs	1,401 44
Supplies	14,920 89
Total	$26,645 34

Rock crushed, 58,450 tons.
Mineral produced, $507\frac{510}{2000}$ tons.

Product in Mineral, year ending June 30, 1884.

Stamp-mill	1,014,510	lbs.	$507\frac{510}{2000}$	tons.
Masses	16,175	"	$8\frac{175}{2000}$	"
Barrel work	13,460	"	$6\frac{1460}{2000}$	"
Total	1,044,145	"	$522\frac{145}{2000}$	"

PHŒNIX MINE.

Up to the first of July, 1883, the Phœnix Co. operated its own mine; but since that date it has been worked by Messrs. Briggs, Delano and Robinson, on tribute, and these gentlemen still have the mine under their control. During 1883 most of the work done was stoping, principally on the 150-level, though a little work was done near the shaft on the 160-level.

There was stoped during the year, 1,712.6 fathoms (superficial) of ground, and 34,353 tons of rock hoisted to surface, of which only 14,255 were stamped. The total yield in mineral was 818,765 lbs., including masses and barrel work. The total cost was $109,987.53.

The low price of copper has had a more than usual unfavorable effect on the mines of Keweenaw Point, and at the Phœnix nothing new in the way of machinery has been put in, and but little opening has been done during the year.

The following statistics have been compiled from the monthly cost sheets:

COST SHEET PHŒNIX MINE FOR 1883.

Mining expense	$67,963 35
Hoisting expense	13,860 40
Shaft-house and tramway	2,182 12
Picked rock expense	215 89

Rock-house expense	$2,096 14
Kiln-house expense	774 08
Stamp-mill tramway	376 97
Stamp-mill	12,744 18
Mineral expense	1,441 13
Hospital expense	707 50
Surface repairs	78 11
Smelting	3,484 37
General expense less sundry credits	4,063 29
Total cost 1883	$109,987 53

Number of fathoms of ground broken, 1,712.6.
Number of tons of rock hoisted, 34,353.
Number of tons of rock stamped, 14,255.
Number of pounds of mineral and mass produced, 818,765.
Number of pounds of ingot produced, 512,291.
Cost per pound of mineral, 13.4 cts.
Cost per ton of rock hoisted, $3.20.

ALLOUEZ MINE.

Since the last report the Allouez has been steadily increasing her plant, and is now in very good condition for economical work, both on surface and underground.

No. 3 shaft has been sunk from the 9th to the 12th level, and considerable work has been done at the north end of the mine—that is north of No. 2. The rock at that end, however, does not come up to expectations, whereas the ground south of No. 1, and below the 4th level, which had always been supposed to be outside the copper chute, has been found to make copper quite satisfactorily.

In levels 5th and 6th south of No. 1, they have been drifting lately, and the ground gives veins and bunches of conglomerate as rich as the Calumet & Hecla. Of course, they are not very large, but they seem to indicate ground which, for the Allouez, will run about a fair average.

Although under ordinary circumstances, with copper higher than at present, it would pay to work the north end of the mine, they have determined for the present to confine operations to the south end, and with that view the hoisting rope from No. 3 will be carried over to No. 1. No. 1 is now operated by an old fashioned beam engine, which also runs the pump. The lowest level of No. 1 shaft is now full of water, having been used during the summer as a reservoir for feed water. It will be unwatered soon and the sinking continued.

The rock hoisted from No. 1 is dumped on a floor, as at the Conglomerate shaft houses, where it is sorted and the good portion taken in trestle cars to No. 2 shaft, where it is again dumped into a side-pocket, from which it slides again into the large trestle cars which conveys it, in addition to the rock from No. 2, to the rock house. This arrangement is necessary at present because of the insufficient capacity of the rock house, which last, however, is being put into better shape, there having been built during the past year an addition on the north end, while at the same time one rock-breaker has been added.

It is at the mill, however, that increased facilities are particularly noticeable — the mill now having sufficient capacity to treat 500 tons of rock per day. An addition has been built in which a new rock bin, one Ball head complete, three Coggin separators, twenty-one Collum washers, two slime settling tanks, two Evans slime-tables, and the necessary launders, pumps, pipes, etc., have been placed. To each Coggin separator there are four roughing jigs, and for each set of four roughers there are three finishers. The head has a double discharge mortar, and is well made and set up. There has also been added a large fire-box boiler which is sufficient, with the old one, to furnish a bountiful supply of steam.

A number of years ago a launder from Gratiot River was laid out, but as it was supported on trestles to a considerable extent it very often froze up solid during the winter. This has been rebuilt, and is for the whole length either on or under the ground where it is safe from frost.

ANNUAL REPORT OF THE ALLOUEZ MINE.

The directors present the following statement of the business of the company for the year 1883:

The product of the mine was 2,408,675 pounds of mineral, yielding $72\frac{71}{100}$ per cent, or 1,751,377 pounds of refined copper, which has realized an average price of $15\frac{13}{100}$ cents per pound, or			$265,066 00
The working expenses at mine, as per detailed statement herewith, were		$241,056 62	
ADD			
Freight	$7,143 69		
Smelting	23,422 65		
Brokerage	1,314 31		
Marine insurance	788 57		
Fire insurance	81 83		
Storage, etc	211 25		
Expenses	5,690 54		
Interest	212 00		
		38,864 82	
Making the total working expenses			279,921 44
And showing a deficiency of			$14,855 44
There has been expended in construction of new machinery and improvements, as per statement appended			$26,525 12
Making the total expenditure in excess of production			$41,380 56
The surplus brought forward from 1882 after disposing of the copper then unsold, was		$73,149 95	
Assessment payable Jan. 3, 1883		40,000 00	
			113,149 95
Leaving a net surplus Dec. 31, 1883, of			$71,769 39

as shown in detailed statement herewith.

The decline in the market value of copper (our sales averaging $17\frac{86}{100}$ cents per pound in 1882, and $15\frac{13}{100}$ cents per pound in 1883,) has prevented the realization of the profit which the directors anticipated as the result of operations in 1883, and although the expenses *per ton of rock handled*, have been considerably reduced—the yield remaining about the same—yet the decline in the value of the copper produced has more than kept pace with the decrease in costs, and the net result is a loss on the year's business as shown by the foregoing figures. It is proper to state that the larger portion of this loss was caused by the breaking down of the only locomotive we then had, in contending with the excessive snows of the winter of 1882–3, which not only caused a decrease in the product, but entailed heavy expenses in hauling rock to the stamp-mill by teams.

It is well-known that this company is engaged in working a large body of comparatively low grade material, and that in order to produce copper cheaply a large quantity should be treated. The mine was originally opened and equipped on too small a scale to meet the requirements of existing circumstances, and although working to the full capacity of our stamp-mill, and by the aid of the improvements recently made in the mill, and the equipment of the mine, we have succeeded in reducing the cost of production (per ton of rock handled) during the past year, very close to the figures of the leading mines of the region, yet the managers can see but little chance for profit while copper sells at 15 cents, or any means of avoiding serious loss should it decline to lower figures, unless either the yield of the rock mined should increase, or a further reduction in the average cost per ton of handling same be effected.

Any considerable reduction in the average cost can only be realized by increasing the output, and thus distributing the fixed charges, and cost of maintaining the organization, over a larger number of tons of material, and as it would not be safe to depend upon any large increase in the average yield shown by the result of the last two years' work, the only alternative seems to your directors to be, to enlarge the capacity of the stamp-mill one-half, and make such additions to the equipment of the mine as will be needed in order to handle a corresponding increase in the output. They have therefore called an assessment on the capital stock, of fifty cents per share, payable Feb. 25th, 1884, in order to provide the means of payment for the improvements indicated, hoping thereby to place the company on a safe basis.

The agent's report, with tables of cost of the work performed and improvements made during the year, also statement of assets and liabilities Dec. 31st, 1883, are herewith submitted for the information of stockholders.

By order of the directors,

JOHN STANTON, *Treasurer.*

ASSETS AND LIABILITIES—ALLOUEZ MINING COMPANY—EXCLUSIVE OF REAL ESTATE AND MINE PLANT.

		December 31, 1883.
ASSETS.		
Cash		$15,926 19
Accounts receivable		852 03
Copper on hand (279,555 lbs.) sold for		42,137 25
		$58,915 47
At Mine.		
Cash	$1,028 87	
Supplies	47,665 15	
Wood and timber (standing)	13,501 34	
		62,195 36
Total assets		$121,110 83
LIABILITIES.		
Agent's drafts	$19,066 51	
Indebtedness at mine	24,223 34	
Accounts payable	6,051 59	
		49,341 44
Balance of assets		$71,769 39

STATEMENT OF EXPENDITURE AT THE ALLOUEZ MINE FOR THE YEAR 1883.

UNDERGROUND EXPENSES.		
Sinking shafts 268.3 feet at $14 36	$3,854 20	
Drifting 1,630.6 " " 9 84	16,050 82	
Stoping 6,523.6 fath. " 6 48	42,300 90	
Sundry contracts	219 25	
Mining captains, timbermen, trammers, blacksmiths and other laborers	36,689 60	
Supplies used on company account	9,089 30	
Cost of running compressor and power drills, including repairs	14,504 30	
Surveying underground	15 00	
	$122,723 37	
Less profit on supplies sold contractors	10,332 50	
		$112,390 87
HOISTING EXPENSES.		
Engineers, firemen, mechanics, etc	$7,203 24	
Fuel	11,106 00	
General supplies	2,754 01	
		21,063 25
SELECTING AND BREAKING ROCK.		
Mechanics and laborers	$14,203 31	
Fuel	5,718, 00	
Castings and supplies	4,235 21	
Teaming	39 50	
		24,196 02

SURFACE EXPENSES.

Superintendence, and wages of mechanics and laborers	$10,910 25	
Supplies used	2,628 89	
Teaming	1,122 73	
Rent of telephones	228 75	
Taxes	2,085 30	
Surveying	77 50	
Insurance	1,445 00	
Sundry expenses	1,012 06	
	$19,510 48	
Less sundry credit items	1,607 70	
		17,902 78

RAILROAD EXPENSES.

Engineers, mechanics and laborers	$6,365 32	
Fuel, rails, ties, supplies, etc.	4,354 70	
		10,720 02

Tons rock transported, 102,388.

STAMP MILL.

Labor and superintendence	$20,127 77	
Fuel (8,330 cords wood)	23,715 40	
Supplies	3,993 25	
Foundry bills, etc.	5,038 88	
		52,875 30

Rock stamped, 102,388 tons.
do per cord of wood, $13\frac{9}{10}$ tons.
Cost of stamping and washing, $51\frac{64}{100}$ cents per ton.

MINERAL EXPENSES.

Transportation to Hancock	$3,919 44	
Barrels and cooperage	980 50	
Assaying	270 00	
		5,169 94
		$244,318 18
Less rents received		4,261 56
Net working expenses		$241,056 62

CONSTRUCTION ACCOUNT.

Second half Rand duplex compressor, drills, etc.	$5,823 85	
Locomotive "Gratiot,"	9,393 46	
Cars, snow-plow, and other fixtures for railroad	4,343 74	
Locomotive house	1,318 06	
Washing machinery, heater, etc., at stamp mill	1,868 28	
Berryman heater at No. 2 engine	919 32	
Sundry additions to machinery at No. 2 engine and rock house	1,536 31	
Reservoir and pipes for feed water, etc.	1,322 10	
		26,525 12
Total expenditure		$267,581 74

SUMMARY OF RESULTS FOR THE YEARS 1882 AND 1883.

	1882	1883
Tons of rock mined	112,892	120,824
Tons of rock hoisted	107,079	116,425
Tons of rock treated at mill	97,232	102,388
Refined copper per ton of rock mined	$14\frac{91}{100}$ lbs.	$14\frac{49}{100}$ lbs.
Refined copper per ton of rock milled	$17\frac{31}{100}$ lbs.	$17\frac{10}{100}$ lbs.
Total yield of mineral	2,299,445 lbs.	2,408,675 lbs.
Total yield of refined copper	1,683,557 lbs.	1,751,377 lbs.
Cost of mining per ton of rock milled	\$1 $33\frac{93}{100}$	\$1 $09\frac{77}{100}$
Cost of hoisting, per ton of rock milled	$20\frac{15}{100}$	$20\frac{57}{100}$
Cost of selecting and breaking, per ton of rock milled	$23\frac{35}{100}$	$23\frac{63}{100}$
Cost of general surface expenses (less rents), per ton of rock milled	$08\frac{67}{100}$	$14\frac{30}{100}$
Cost of transportation to mill, per ton of rock milled	$13\frac{58}{100}$	$10\frac{47}{100}$
Cost of stamping and separating, per ton of rock milled	$55\frac{52}{100}$	$51\frac{64}{100}$
Cost of expenses on mineral, per ton of rock milled	$05\frac{17}{100}$	$05\frac{05}{100}$
Total net working expenses, per ton of rock milled	2 $60\frac{37}{100}$	2 $35\frac{43}{100}$
Total net working expenses, per ton of rock mined	2 $24\frac{26}{100}$	1 $99\frac{51}{100}$
Cost of freight, smelting, and marketing product, including New York office expenses, per ton of rock milled	$40\frac{50}{800}$	$37\frac{96}{100}$
Gross value of product, per ton of rock milled,	3 $09\frac{37}{100}$	2 $58\frac{88}{100}$
Cost of copper marketed, and all expenses paid, per pound	$17\frac{88}{100}$	$15\frac{98}{100}$

AGENT'S REPORT.

ALLOUEZ MINE, L. S., MICH.,
JANUARY 21, 1884.

JOHN STANTON, ESQ.,
Treasurer Allouez Mining Company, New York.

DEAR SIR:—I take pleasure in submitting my annual report of operations at our mine for the year ending December 31st, 1883.

No. 2 shaft has been sunk 110 feet, from the 14th to the 15th level. About midway the shaft passed through the crossing, and has not since carried any copper; the ground on either side of the crossing has always been found much disturbed and barren. The drifts north and south of the shaft at 15th level have been driven 45.5 and 26.8 feet respectively. The former is showing a good course of copper ground while the latter is yet poor.

The 14th level north of No. 2 shaft has been advanced 281.2 feet; total distance from shaft, 307.7 feet. For most of this distance the drift has shown remarkably well, but is now quite poor. The stopes in this back have yielded a good quality of rock until the past four months; at present the rock obtained from them is of a lower grade. This level south of shaft, has been driven 21.5 feet to the crossing; total distance from shaft, 43.5 feet. All the ground in this back has been stoped down, and gave very fair returns.

The 13th level north of No. 2 shaft has been driven 185.7 feet; total distance from shaft, 428.1 feet. During the last month's drifting the ground has been poor, the stope following the drift has also become so unproductive that further work has been discontinued for the present. The unexpected unproductiveness of the lode in this, as well as the level below, at points where we had every reason to look for good copper ground, has been the means of curtailing our product for the past three months to a considerable extent. Drifting south of No. 2 shaft and south crossing at 13th level has been resumed the past month, and 12.6 feet driven; total length from shaft, 114.6 feet. The breast shows some copper, and I look for better ground ere we advance much further.

The 12th level south of No. 2 shaft was advanced 117.1 feet; total length from shaft, 338 feet. About 50 feet south of the crossing very nice copper ground was cut into, which continued very uniform to the present head of drift. A stope now worked in this back is giving very satisfactory results. This level north of No. 2 shaft has been extended 289.9 feet; total length from shaft, 813.8 feet. The present head of drift shows some copper but cannot be considered good stoping ground. As in the previous year, the work done in this level has not given remunerative returns.

The 11th level north of No. 2 shaft was advanced 172 feet; total length from shaft, 814.3 feet. The drift has opened some good stoping ground, but is not showing so well at the present point. A crossing passed through at the 2d, 3d and 4th levels, north of No. 3 shaft, will be encountered within a short distance, and the ground in the vicinity of such crossings has always been found disordered and non-copper bearing. A stope worked in this back has produced well, but reached the end of productive ground some months ago.

The 10th level of No. 2 shaft has been extended 192.5 feet; total distance from shaft, 746.7 feet. The head of drift is poor, but has only been so for the last few feet. The rest of the ground passed through will all pay to stope down. A stope has been worked in this back constantly the past year, giving fair results.

No. 3 shaft has been sunk 158.3 feet, and been extended during the past year from a point 46 feet below the sole of 7th level to the 12th level. Partly, it has been opened by rising stopes from the levels underneath the line of shaft. The skip road is completed to the 10th level, and will shortly be extended to the 12th level.

The 10th level north of No. 3 shaft has been advanced 25 feet; total length from shaft 150 feet. The head of drift shows some copper. A stope worked in this back during the past summer gave extraordinary good returns, considered in connection with the average productiveness of our lode. It proved to be limited in length, and has been exhausted.

The 9th level north of No. 3 shaft has been extended 135.8 feet; total length from shaft, 238 feet. The drift has carried some copper however not continuous, and of a bunchy character. The stope near and some distance north from shaft, has yielded very well; further north it has partaken of the nature of the drift.

The 8th level north of No. 3 shaft has been advanced 53 feet; distance from shaft, 124 feet. The head of drift has entered a barren lode, and a stope worked in this back yielded pay rock for only a short distance upwards, when the lode became too poor to work.

The 7th level north of No. 3 shaft has been driven 72 feet; total distance from shaft, 143.8 feet. The lode passed through has been poor, and no stoping has been done in this back. At this level, south and near No. 3 shaft, a stope of about 140 feet in length has been worked for the past year. The rock broken has been of a fair quality, and its outlook for the future is about the same.

The ground broken during the year was

Sinking shafts	268.3 feet.
Driving levels	1,630.6 "
Stoping	6,536.9 fms.
Ground broken in openings	810.1 "

Under the head of "Construction" the following additions and improvements have been made to our mine plant. Second half of "Rand Compressor," 16½ x 30, with four No. 3 Rand drills; feedwater heaters to stamp-mill, hoisting engine and compressor; new firebox to one of the boilers at hoisting engine; new cylinder and piston to rock-house engine; Evans slime-table, separator with other additional washing machinery, and new grate punching machine, at stamp-mill; new locomotive, round-house and snow plow; sixty-one tons of fifty-pound steel rails for railroad; and water reservoir at mine.

The locomotive "Gratiot" was received shortly after opening of navigation, and put into service the first of July, since which time it has been doing constant duty, performing the work very satisfactorily and with economy. It will be fully equal to the increased duty required of it in the near future. Our old locomotive has been thoroughly overhauled, and will be in condition for service in any case of emergency. The feedwater heaters deliver the water to the boilers at a temperature of 200 to 212° Fah., and since in use have lessened the consumption of fuel. The stamp-mill with dressing plant is in good working condition, and has done excellent duty the past year. The machinery at the mine, together with general mine plant, is also in good condition for future operations.

The past winter has been so very severe and stormy that our old locomotive, in its crippled condition was not fully able at all times to transport a sufficient supply of rock to the mill, particularly during January and February. Frequent delays occurred diminishing the output and yet increasing the running expenses, on account of having had to keep a constant force of men on the track, to keep it clear of snow. The consumption of fuel was also more than it would have been had the boiler not been in a leaky condition.

Several amygdaloid beds have been explored to some extent the past season. Three of them to the west of our conglomerate have, as far as examined, no practical value. The last one, to the east of our lode and near the rock-house, has shown some copper, where stripped along its lay on surface. Not enough work has been done on it yet to determine its merits, and it ought to be further prospected the coming summer.

A cistern has been blasted out of the solid rock, for the purpose of saving and accumulating feed water for our hoisting engine. At the mill a new line of launders from "Hill's Creek" dam to the mill has been put up, the old launders being too much decayed for further use. These two last items, together with exploration work, entailing a considerable outlay, have been charged to ordinary running expense.

Although successful the past year in making a further reduction in the cost of handling our rock per ton, through the different departments, as compared with previous years, the decline in the price of ingot copper has been so marked that all our efforts could not compensate for it. The appearance of the mine for the next year's output is encouraging. The 15th level is now fully available and ought to give us considerable good stamp rock. The ground south of No. 2 shaft and south of crossing, as far as opened at the 10th and 12th levels, the past year, promises very well and can speedily be made available from the 20th to the 15th level.

The clerk's tables of cost will show in detail, the expenditure in the several departments of the mine for the past year. The underground plan, made by S. G. Emerson, C. E., will more succinctly convey the work done in the mine. It gives me pleasure to be able to state that my associate officers have been untiring in the performance of their duties.

Very respectfully yours,

FRED. SMITH, *Agent.*

HOUGHTON COUNTY MINES.

QUINCY MINE.

The man engine is down to the 27th level, below which it is necessary to use the ladders, in descending to the bottom of the mine. No. 2 shaft is down to the 33d level, and a drift is being run north. No. 4 shaft has reached the 32d level, and a drift is in progress north to meet the drift, from No. 2. The ground in the vicinity of No. 2 shaft seems to be the best; in fact, the north end of the mine is the richest in mineral. The opinion given by the former agent, Mr. F. G. White, that the rich ground was dipping to the south seems to have been verified by last year's work. Although the north end of the mine is the best, yet there are many good stopes of excellent stamp work in the vicinity of No. 4 shaft. The masses are mostly found at the north end, and fortunately for the Quincy, they are not excessively large.

The Quincy drifts are made rather small on account of the large amount of exploratory work done. The drifts are 7 feet high and 5 feet wide; they use two machine drills on the same column, and open up by a bottom cut, the first blast blowing a wedge out of the bottom, and the holes as they are put in higher up becoming more horizontal till at last the top ones, which square up the corners, are reached. This method of opening gives a clean, smooth drift, and requires a minimum of rock to be moved. The tram cars are larger than usual, and the trammers are paid by the month. Great care is taken in having the miners put their holes in as carefully as possible, and the young men who are given stoping contracts are carefully coached by their bosses and captains.

The Quincy employs the diamond drill constantly, and by this means the management is enabled to locate the subsidiary veins or amygdaloid lodes which occur in the foot. It is probably understood by all conversant with amygdaloid mining that an amygdaloid bed is merely the top of a trap deposit which has been metamorphosed, and that there is no definite foot wall. The hanging wall is sharply defined by the next trap lode adjoining, while the foot runs off insensibly and irregularly into trap. Sometimes the copper is disseminated through the entire mass, as in the Atlantic ash bed; again, it is in irregularly distributed bunches as at the Osceola; or, again, it may lay close to the foot and to the hanging, with a horse of barren material between, as in the Kearsage amygdaloid in which the Wolverine is located. The Quincy people long ago recognized the irregularity of their deposit, and by a judicious use of the diamond drill in cross-cutting have done much to familiarize themselves with the lode. The mining captain, Mr. John Cliff, has made a study of the geology of the region and much credit is due to him for the successful prosecution of the underground work.

The systematic manner in which the Quincy long ago explored its property, when its old fissure vein proved itself poor, should be an example to other owners of property on the Mineral Range where there are unquestionably many good workable deposits yet to be found.

Since the agents report for 1883, a new Rand compressor has been added to the plant, and the mine now has an abundant supply of air. The rock-house has been supplied with grates upon which the cars dump their contents, thus saving considerable in the handling of material, which comes from the mine fine enough for the stamps.

At the mill the usual spring repairs were made, and the old smoke-stack which towered above the center of the mill has been removed. A new boiler has been placed in the boiler-house, and the pumps have been removed to an addition built alongside the mill. The docks have been enlarged, and a coal-bin built, with pockets so arranged that the coal can be automatically loaded into wagons without any handling whatever.

There were mined 117,171 tons of rock; of this 101,415 tons were hoisted and 97,100 tons treated in the mill. This produced 6,741,150 pounds of mineral, which yielded 5,549,087 pounds of ingot copper.

REPORT OF THE COMPANY'S OPERATIONS IN 1883.

The directors submit the following report of the business of the mine for the past year, and statement of the financial condition of the company.

The shipment of the season was 7,305,970 pounds of mineral, which has been smelted, and yielded about $82\frac{3}{10}$ per cent., or 6,012,239 pounds of refined copper.

The product of the mine for the year, as prepared for shipment, was 6,741,150 pounds, or $3,370\frac{1150}{2000}$ tons of mineral, of the following description, namely:

Stamp copper	6,535,045 lbs.
Mass "	206,105 "
	6 741 150 lbs.

for which, estimating copper on hand at 15 cents per pound, and the product left over at the mine at 82 per cent. yield, has been realized the

gross sum of	$828,300 04
Realized from sale of silver	2,482 96
	$830,783 00

The expenses for the year are as follows:

Running expenses at mine		$398,377 32
Building and construction account		21,782 37
Smelting, transportation, and all other expenses		119,878 58
		$540,038 27
which, deducted from gross earnings		830,783 00
leaves a mining profit		$290,744 73
There has also been realized during the year from interest		5,286 38
		$296,031 11
The statement of assets and liabilities in our last report showed a balance on hand, as of date January 1, 1883		$663,867 64
Add earnings of 1883		296,031 11
		$959,838 75
Deduct dividend of February 15, 1883	$240,000	
" " " August 15, 1883	140,000	
		380,000 00
Leaving balance of assets, January 1, 1884		$579,898 75

A dividend of $4.50 per share, or $180,000, payable February 20, has been declared, which with dividend of $3.50 per share, paid August 15 last, makes total for the year, $320,000.

The usual financial statements are presented, and the report of the year's work, and improvements in progress, as prepared by the retiring agent, Mr. F. G. White, who resigned at the end of the year to assume important duties elsewhere. Capt. Samuel B. Harris has been appointed in his stead.

All of which is respectfully submitted,

THOMAS F. MASON,
President.

NEW YORK, February 12, 1884.

GENERAL SUMMARY OF RECEIPTS AND EXPENDITURES OF THE QUINCY MINING COMPANY, FROM ITS ORGANIZATION TO DECEMBER 31, 1883.

RECEIPTS.

From capital stock paid in	$200,000 00
" Proceeds copper and silver (70,791,791 lbs. copper)	15,513,974 71
" Interest	100,734 33
" Profit on sale P. L. & R. Improvement company stock and other investments	79,637 16
" Sales of real estate, Hancock, Michigan	47,006 68
	$15,941,362 88
By balance brought down, being receipts over expenditures	4,289,898 75
Deducting dividends declared, 1 to 30 inclusive	3,710,000 00
Leaves balance as per statement in detail below	$579,898 75

EXPENDITURES.

For expenditure on location previous to 1856	$42,097 98
" " " Quincy vein, 1858, not now worked	55,000 00
" Openings and explorations on 3,800 feet "east" or Pewabic vein, extending to Portage Lake, preparatory to future work	11,500 00
" Real estate and permanent improvements on same, including dwelling houses, stamp mill, machinery, steam engines, tram road, dock, warehouse and other buildings and roads	873, 326 20
" Mining and surface labor, expenses of smelting and marketing copper, and all incidental expenses	10,669,529 95
Balance carried down	4,289,898 75
	$15,941,352 88

STATEMENT OF ASSETS AND LIABILITIES, EXCLUSIVE OF REAL ESTATE, MINE PLANT AND SUPPLIES IN USE, JANUARY 1, 1884.

ASSETS.

Loans on call	$150,000 00
Cash in bank	20,827 96
Cash on hand at mine	7,395 05
Copper on hand (unsold, estimated at 15c. per lb.)	276,448 20
Bonds Mineral Range R. R. Co	6,500 00
Accounts receivable (since paid)	22,584 08
	$483,755 29

LIABILITIES.

Drafts unpaid	$4,405 88	
Dividends unpaid	2,217 50	
Accounts payable in New York	18,000 00	
" " at mine	35,920 32	60,543 70
Balance available assets		$423,211 69
Add at mine 484,965 lbs. mineral, at 82 per cent, makes 397,671 lbs. copper at 15 cts per lb	$59,650 65	
Add at mine supplies per inventory on file	70,307 10	
" Farm account, horses, wagons, etc	26,124 54	
" Accounts receivable	604 87	156,687 16
Total balance assets		$579,898 75

Less dividend payable February 20, 1884, $4.50 per share, $180,000.

SUMMARY FOR THE YEAR.

Average force employed	453 men
" number of miners	165 "
" wages of miners on contract, per month	$46 02
Yield of mineral per fathom of ground broken	1,035 lbs
" refined copper per fathom of ground broken	850 lbs
Total rock mined	117,171 tons
" " hoisted	101,415 "
" stamp rock treated	97,100 "
Yield of stamp rock treated (.03$\frac{36}{100}$ per cent)	6,535,045 lbs
Product mineral	6,741,150 "
" refined copper	5,549,087 "

AGENT'S REPORT.

QUINCY MINE, LAKE SUPERIOR, MICH.,
DECEMBER 31, 1883.

We again take pleasure in submitting the report of another successful year.

Both shafts have been sunk to the thirty-first level, which is now being opened, and sinking resumed to the thirty-second level in No. 2 shaft. The twenty-ninth and thirtieth levels have been connected between the shafts, and drifting continued north of No. 2 shaft, and south of No. 4 shaft. Near, and north of No. 2 shaft the drifting has developed very productive stoping ground, while in south end of mine, or in vicinity of No. 4 shaft, results have been fairly productive; yet more moderate than we had hoped for, the bodies of stoping vein being of smaller proportions than in the more northerly portion of the mine, while the stoping of the past several years north of No. 2 shaft plainly indicates at this time that the copper bodies have a decided strike or inclination to the south, and by the mine plans submitted herewith you will notice the heavy bodies as indicated by stoping done north of No. 2 shaft, though at considerable distance from shaft at the twenty-fifth level, are in close proximity at the twenty-ninth, thirtieth and thirty-first levels.

The greater part of the drifting for the year has been done below the twenty-sixth level, and you will notice the number of feet driven is in excess of previous years, somewhat increasing the reserves, leaving the mine in fine condition for future production, and the lower levels give full promise of good results.

We have driven both the twelfth and twenty-second levels south of No. 4 shaft with only moderate results, yet of sufficient importance to warrant a continuance of the work at these points.

The plan of changing the skip and road in No. 2 shaft commenced during previous year was successfully carried out in June last, and places the shaft in condition to admit of another skip and road when the demand for increased hoisting facilities shall require it.

We have also placed two angle bobs of iron at the twenty-fourth level in man engine shaft, and extended the rods of man engine to the twenty-seventh level, and which can now be extended as may be needed. The rods to pump and man engine have many of them been replaced during the year, and both are now in good repair, except the angle bobs at the surface connected with man engine, being of wood, show decay, and will require repair in the near future.

During the past year we have placed dumps in each shaft at the several points where feasible to reach worked out stopes, and, so far as practicable, the waste or poor rock has been dumped into those open places, a course that may be continued to advantage; this, with the change of No. 2 engine, which was removed to the new building in June last, at which time the new hoisting gear was put in order for hoisting, has greatly increased the hoisting capacity of this shaft, relieving the work of delays experienced before the change—the gear and engine working very satisfactorily. No change has been made at No. 4 engine and shaft, other than ordinary repairs; but attention will soon need be given to the foundations of that engine.

The new boilers have continued to prove satisfactory, as has the compressor plant and pumping engine. The compressor's air cylinders will require overhauling early in the new year.

At the rock house a new cylinder and pillar block has been provided for the engine, and the machinery at this point is now in good repair; no other change has been made, but we would strongly recommend a change in the trestle and the dump, to provide for screening the fine dirt and rock directly into the chutes, and thus avoid some expense in handling.

At the stamp-mill new boilers were purchased and a new boiler-house erected, the boilers placed in position, and are now in successful use; the old ones still remain in place. The consumption of fuel with the new boilers promises to be less than with the old plant, but they have not been in use a sufficient length of time to draw exact conclusions.

The usual repairs were made upon mill and machinery during June, and the results in stamping have been similar to previous year. The filling of the waste sand has been continued in front of new dock, and so far as necessary the dock and bulkhead have been completed. The work has proved an entire success, and as the ground is filled the dock can be finished.

An addition has been built to the clerk's house, and the repairs upon tenement houses have been made, and nearly all are now in good condition, there still remaining some fifteen not yet repaired.

The usual statements and tables will be prepared by Mr. Kloeckner, and will show you the several costs and results; also the accompanying plans of the mine, prepared by Messrs. Emerson and Southworth, will show the location of ground stoped as well as the advance made in openings.

It again gives me pleasure to commend assistance rendered by my associates.

F. G. White, *Agent.*

HANCOCK MINE.

There has been no change in this mine during past year. They have the skip road down to the 10th, and are hoisting from that level.

At the rock house a new rock breaker has been provided, but is not yet set up. The rock house is considered quite a model in its way, and when in good working order will be very economical. It is situated over the only shaft the mine has, and has excellent pockets for holding a goodly supply of rock.

The machinery of the mine consists of one duplex Rand compressor, which runs six drills, and one vertical hoisting engine. This vertical engine is reversible, and is supplied with an automatic governor. It operates a shaft on which are two V friction pinions, which run two drums—one hoisting from the mine, and the other operating the tram road. The rock is sent from the mine to the mill by cars on an incline about 1,000 feet in length. Two cars are sent at a time, and after dumping at the mill chutes are hauled back up to the rock house by a wire rope. This trestle passes over the main street of Hancock, and under the Mineral Range R. R track. The lower end of the trestle curves around at right angles to bring the cars over the mill chutes.

The mill is supplied with one Ball head which stamps about 200 tons of rock per day. During the summer the sands are treated in a tail house, but during the winter months the tail house is abandoned. A short incline runs from the dock connecting with main incline to the mine, and up this coal and supplies are hauled.

It was rumored last May that the mine would close down, but the statement was unfounded.

The mineral from this mine is smelted at the Lake Superior Native Copper Works, on the Houghton side, and is remarkable for the large amount of iron it contains. Whether this iron occurs in the rock, or is resultant from the stamps and linings I am unable to say. The presence of so much iron makes the process of refining the copper more difficult, as a higher heat is required, and the iron oxide attacking the silica of the bricks makes a fusible slag, and scours away the furnace lining.

PEWABIC MINE.

In writing of the Pewabic, I am obliged to note the peculiar distribution of copper in the amygdaloid beds which has rendered the mine so unproductive in the lower levels. Down to the 25th level the Pewabic was a good paying portion of the

Quincy lode; but at that depth the rock began to grow poorer and poorer, and for the last nine levels, with the utmost economy, it has been impossible to get out a sufficient amount of copper to pay.

Situated as it is, the Pewabic should show, if not as rich rock as the Quincy, at least as good as the Franklin; but such is not the case, and now at the 34th level it stands a well opened mine in a poor spot. Cross-cuts have been driven into both the hanging and the foot at various levels, and during last winter the diamond drill was used to a limited extent. These explorations have cut other lodes but they are all poor. The Allouez conglomerate, which had been encountered in the old Pewabic cross-cut was cut by the diamond drill but showed no copper. At the 25th level the Pewabic was the richest, a "boil" of copper, as the miners term it, occurring at that point. It was here that the chutes from the Quincy and the Franklin met, and they seem to have consolidated their richness at one point and then to have died out. When the 29th level was reached, copper was found south at a distance of 200 feet in a small chute which extended upward and to the south into the 28th level, but not downward or to the north. At the 30th level a mass was struck immediately in the line of the shaft, which ran off into copper to the south and probably went into Quincy ground. A drift was then started midway between the 30th and the 31st called the 305. From here down the rock has been very poor, and last spring, in consequence of certain legal complications, the mine was closed.

The accompanying report will be of interest.

FRANKLIN MINE.

This mine is the most northerly one which has been successfully wrought in the immediate vicinity of Portage Lake. It is south of the Mesnard (not now in operation), and north of the Pewabic, which is also closed down. The Franklin and the Quincy, existing as they do, with barren patches on both sides of and between them, show the variability of richness of the lodes on the copper belts. To characterize the Pewabic, however, as a barren patch between the Quincy and Franklin, is hardly accurate; it is only in the lowest mine levels that the Pewabic has proved barren.

At the Franklin, the three working shafts are Nos. 2, 3 and 5. No. 2 is the nearest to the Pewabic, and has been sunk to the 26th level, which has not been drifted upon, however. No. 3 shaft is down to the 24th level, and preparations are being made to sink to the next level immediately. No. 5 shaft is sunk to the 23d level. Just north of No. 2 shaft the present richest part of the mine is to be found; in the stope on the 25th level north of No. 2 there is a fine showing.

Drifting by hand is being carried on from the 18th level down on the north end towards the Mesnard property. Near the bottom of No. 5 there is a show of considerable barrel work and small mass copper. In the upper levels they are getting out a considerable amount of copper by stripping the foot wall of some of the old stopes that have been beaten away. No. 3 shaft is being sunk in the hanging wall at the bottom levels to preserve a regular dip of 52 degrees 30 minutes. This angle has been determined by Mr. L. G. Emerson, M. E., to be the general dip of the lode.

In sinking the shafts instead of leaving a pillar at the bottom of the old level when the new lift is begun, and afterwards removing it when the shaft is ready for the skip road, they build a timber pentice for the skip to rest on and sink straight down. The former method is used at the Quincy. The Franklin can sink by their method at less cost and, they claim, with perfect safety.

On the surface no changes of a radical nature have been made. No. 3 shaft house has been rebuilt and furnished, and the others supplied with grates, or "guzzleys," as they are called in the far West, for the skip to dump upon.

The Franklin has no distinct rock house, the rock being sorted in the shaft houses. Considerable saving is effected by this means, the cost having been reduced from 23 cents to 6 cents per ton of rock treated. As it now is, the rock is all transferred and dumped by hand-cars from the shaft houses to the bins near No. 3. At each shaft house there are three track approaches to the floor. They are laid at such a level that the top of the cars and the floor are at the same height. Two tracks are for stamp-rock; one for poor rock. It is found that the guzzleys serve to separate the trap, which to a great extent is in flat pieces, which drop through the apertures and are then picked out by hand.

The mine has its own saw mill on the location, in the same house in which the two large stamps for treating masses are located. Connected with this house is a small power saw for sawing cord wood.

The exhaust steam from the main engine is now carried by a very large pipe to the locomotive house, where there is a large shell, in which the steam expands still farther, giving up considerable heat to the atmosphere. The exhaust is nearly all condensed, giving good feed water, a great desideratum on the Franklin hill.

The pumping plant for the Franklin and the Pewabic, designed by Mr. J. W. V. Rawlins, engineer, to pump water from Portage Lake has proved a great success.

The rock road from the mine to the mill, which runs along the top of the bluff is in good working order, and is supplied with two locomotives.

During the year 1883 there were treated 125,775 tons of rock which yielded 3,489,308 pounds of ingot copper. An accurate map of the Franklin and Pewabic, in which the surveys of the two mines have been connected, is under preparation by Mr. L. G. Emerson, M. E., and will accompany next year's report.

ANNUAL REPORT OF FRANKLIN MINE.

Herewith we hand you a full report, from our agent, of the working of the mine for the year ending December 31, 1883, and the usual statements of receipts and expenditures, as well as of assets and liabilities; the former showing the sum of $\$225{,}194\frac{32}{100}$, after paying the dividend, January 1, 1884, of $80,000.

It will be readily seen that the mine has made a handsome gain during the year, enabling the directors to pay a dividend of $2 per share, and also to allow of quite a sum, discount for over-valuation of copper, January 1, 1883, estimated "18 cents per lb. which was afterwards sold at a loss of nearly 2½ cents per lb," and still have an amount of assets nearly equal to that of January 1, 1883; and the future of the mine, seems from our agent's report, and his letters of later date, to be much more promising than ever before. It is also very gratifying to prove, as has been done, beyond a doubt, that the mine is all and even more than it ever has been claimed to be by the directors.

The enterprise has been conducted from its inception in an honest, straight-forward, business manner, and although from the fact of calling no money from the stockholders, it has taken several years longer to arrive at success, still the end has been gained, and successfully too, and the Franklin mine to-day stands in as good and promising condition as any mine of its class in the country.

It seems almost needless to add that, to our agent, Captain Johnson Vivian, great credit is due for the successful termination of our enterprise.

For the Directors,
D. L. DEMMON,
Treasurer.

OFFICE OF THE FRANKLIN MINING COMPANY,
HOUGHTON COUNTY.
HANCOCK, MICH., January 10th, 1884.

D. L. DEMMON, Esq., Treasurer.

DEAR SIR:—With regard to our operations for the year ending December 31, 1883, I beg leave to submit the following report, with map of the mine, which has been very carefully surveyed and platted by Mr. Henry C. Southworth, M. E., together with inventory of supplies, tools, and machinery, and tabular statements, showing in detail the cost of each department of our works, which have been neatly compiled by Mr. Arno Jaehnig; this data is so complete that comment from me is unnecessary.

SURFACE WORK.

The contemplated railroad from the bottom of the incline road to the lake, of which mention was made in my last annual report, has been constructed, and a small engine placed at the head for transporting loaded cars from the dock to that point, after which they are transferred to the incline road and sent to the mine.

With this arrangement, we can deliver coal from the dock into the boiler houses on the mine for 30 cents per ton. At the head of the incline, 250 feet of trestle work have been put up, on which a side track is laid for switching on the up-loaded cars, which is very convenient in making up trains. At the mine, 1,050 feet of elevated railroad have been put up on which the loaded cars are pushed by the locomotive to the point were they are unloaded. A rock-bin, to replace the old one which was too badly decayed for further use, has been built. Also 170 feet of very substantial shed, inclosing rock-bin, railroad, etc., which will materially lessen the cost of loading the cars for the mill.

MACHINERY.

All the machinery has worked satisfactorily; nothing in this direction has happened to cause any important delay or extra expense. Everything in this department is in good running order except the hoisting drum for No. 5 shaft, which will require rebuilding. The castings for it are at the mine, and will be put up some time during the coming month. For the last three years we have suffered from time to time, especially in winter, for the want of feed-water for the boilers; and, owing to the very unusual dry summer, we were compelled to haul water with teams last fall to supply our machinery. To obviate this difficulty in the future, we have purchased a half interest in a steam-pump which is located in the Pewabic stamp-mill, with a mile of four inch pipe, leading from the mill to the mine, which will be in operation in a few days, and will doubtless supply both mines with all the water necessary.

STAMP MILL.

The mill treated 125,775 tons of rock, which is 7,405 tons more than was stamped in 1882. It will be necessary to stop two heads of stamps for at least three weeks, to make the following repairs: new frame, one row of timber on the foundation, and some stone work under the engine; all of which we shall do in February, which will place the mill in as good condition as it has been for many years.

MINING WORK.

No. 2 shaft has been sunk from the twenty-third to the twenty-fourth level. The lode exposed in this opening contains copper in paying quantities. The bottom level has been opened 220 feet, all of which will pay to stope. The twenty-third level has been extended south 293 feet, and is now within 60 feet of the boundary line of the Pewabic. The lode at this point is large, and the greatest portion of it will no doubt pay to remove; but, on the whole, it is not so rich as the ground north of the shaft. This level has been extended north 225 feet. The lode for the entire distance has yielded a large amount of good stamp rock, some masses, and considerable barrel copper.

The twenty-second level has been extended south 45 feet, and north of the shaft 157 feet, and connected with No. 3 shaft. The former opening is poor, while the latter has not exposed anything of much value. A large portion of this back has been stoped, but did not afford much profit.

No. 3 shaft was sunk from a point 25 feet above the twenty-second to the twenty-third level. Owing to a bend in the lode toward the east at this point, the shaft was sunk in the hanging wall rock, consequently it is unproductive. The bottom of the shaft is 60 feet to the west of the lode. A cross-cut has been started from the shaft, which will reach the lode about the first of February. The twenty-second level has been extended north of this shaft 142 feet, and connected with a winze from the level above. All of which work has exposed remunerative ground. The twenty-first level has been extended north 225 feet, through a large and profitable lode. The twentieth level has been drifted north 240 feet, and connected with No. 5 shaft. The lode at this point has yielded a fair amount of stamp and barrel copper. No. 5 shaft has been sunk from the twentieth to the twenty-second level, and the twenty-first level opened north 202 feet. All of which openings are through very valuable ground, especially the last 90 feet of the shaft, which is the richest piece of lode we have ever opened. The twentieth, nineteenth, and eighteenth levels have been extensively opened north of this shaft, and a large amount of ground is ready for stoping, most of which will pay a profit.

The lode in the eighteenth level is carrying copper in paying quantities further north than any yet found in the levels above. We intend to push this level along as fast as possible during the coming year, to prove up the unexplored territory between this point and the boundary line of the Mesnard.

FUTURE PROSPECTS.

Everything at this time seems to indicate that a product for the ensuing year of at least 2,000 tons can be made, from which, with copper at even 15 cents per pound, a handsome profit will be realized.

Mr. Arno Jaehnig, the clerk, and Captain Thomas Dennis, are still with us, and, as usual, take pleasure in promoting the interest of the company. Mr. James Moor, who is in charge of the machinery, has attended to the duties of his position with more than ordinary zeal and ability. And to him, as well as Messrs. Jaehnig and Dennis, I feel myself under renewed obligations. I am, Yours Respectfully,

J. VIVIAN,
Superintendent.

Cash Receipts and Expenditures of the Franklin Mining Company, for the Year Ending December 31, 1883.

Cash on hand January 1, 1883	$ 21,912 66
Cash received from sale of 3,418,456 lbs. copper, at $15\frac{661}{1000}$	535,389 78
Cash received from sale of silver	850 40
Cash received from sale of supplies	800 00
Cash received from interest	1,055 35
Cash received from loans,	53,500 00
	$613,508 19

Contra.

Cash paid loans	$ 73,500 00
Cash paid mine agent drafts	367,756 91
Cash paid interest	544 58
Cash paid insurance and storage	3,395 74
Cash paid smelting and freight	51,724 85
Cash paid expense, brokerage, copper charges, taxes, etc.	9,236 05
Cash on hand December 31, 1883	107,350 00
	$613,508 19

Statement of Assets and Liabilities of the Franklin Mining Company, January 1, 1884.

Assets.

Copper on hand, 1,386,110 lbs., at $14\frac{7}{8}$	$206,183 87
Cash on hand	107,350 06
Supplies at mine	69,482 49
	$383,016 42

Liabilities.

Drafts outstanding	$31,808 75	
Smelting, November and December	8,206 92	
Freight	1,389 02	
Liabilities at mine	36,417 41	
		77,822 10
Balance of assets, December 31, 1883		$305,194 32
Less dividend paid January 1, 1884		80,000 00
Balance assets		$225,194 32

There is in the mine broken, but not hoisted, 25,256 tons of rock which is not valued as an asset.

During the year, 125,775 tons of rock was treated at the mill, producing 4,305,315 lbs. mineral, which yielded 3,489,308 lbs. of ingot copper, or $81\frac{04}{100}$ average.

The amount of mineral per ton of rock was $1\frac{71}{100}$.

The gain in ingot over 1882 was 225.388 lbs.

Yield in 1881, 2,667,952 lbs. refined copper.

Yield in 1882, 3,264,120 lbs. refined copper.

Yield in 1883, 3,489,308 lbs. refined copper.

PENINSULA MINE.

The Peninsula is working on conglomerate No. 15, described by Pumpelly in his geological survey of Michigan. This conglomerate is exposed east of the Atlantic, and is traceable as far as the Delaware. It is there that the deposit has been opened by the Conglomerate Mining Co. At the time of my visit the mine was opened to the fifth level, and the ground pretty well beaten away. The openings had been allowed to fall behind, and the consequence was that during the past summer there was not always sufficient rock on hand to keep the mill going. No. 1 shaft is down to the sixth level, and preparations were being made to sink No. 2 shaft to the same level.

The copper in this mine, as in most of the conglomerate mines, runs in pay chutes, having a dip to the north. There are four well-defined chutes in the Peninsula, and they dip at a rate of thirty feet to the hundred in depth.

No. 1 skip road was designed for a double skip-way, and two tracks were laid, and two drums put in the hoisting-house. It was operated double for some time, but was finally abandoned, and No. 2 shaft was sunk and used. The skip-way in No. 1 is still intact, and at some future time it is proposed to restore it to use. Certainly, the advantages of counterbalancing are great; but in the copper mines as worked to-day with inclined shafts, and some not very deep, they are not sufficient to warrant the introduction of double roads. At the Osceola, where a double hoist is being put in, it is proposed to run each skip separately, for a time at least. One of the great advantages of a double skip, aside from counterbalancing, is the increased possible output from a single shaft, with only a slight increase in the cross section of the shaft itself.

At the mill they now have two steam stamps. These stamps are virtually Ball heads, with iron frames, and are the same as those in use at the Conglomerate. They were built by the Cuyahoga Works. Coggin separators are used, and Collum jigs. They have no slime-tables, but use vanning machines.

The water for the mill is pumped up from a station located near the M. R. R. R., and so far there has been enough of it for the two heads.

OSCEOLA CONSOLIDATED MINING CO.

During the year 1883, most of the sinking and drifting has been in the vicinity of Nos. 3 and 4 shafts, around which considerable ground has been opened up. Stopes in the neighborhood of shafts 1 and 2 furnished most of the rock raised during the year. The facilities for hoisting from 1 and 2 are better than formerly, but new machinery is to be put in, by which the ground broken in the space between 2 and 4 can be raised to the surface. With this view, an order has been placed with the Reliance Works of Milwaukee, Wis., for a direct acting double drum hoisting engine, the cylinders of which are to be 20 inches diameter and 60 inches stroke. This engine will be placed back of No. 3 shaft, in the house already prepared for it, and will then be used not only as a double hoist, but as an elevator or man-engine for the men. By its use the engine will be relieved of the unnecessary lifting of the dead weight of the skip, having only friction and the weight of the rock to overcome. A new locomotive boiler is already set to furnish the extra steam.

Stoping has been pretty general in the mine from the 3d to the 10th level, the 11th and 12th levels having been broken into only to a limited extent. The width of the stopes varies from seven to fifteen feet.

Large blocks of ground still remain in the upper levels. The ground as usual has fluctuated in richness, but by keeping large amounts open ahead an average result has been obtained.

One good pay chute runs from north of No. 4 shaft, near 4th level, south and down to the 10th level, where it is on the south side of the shaft. This is being worked, and indications point to a probable increase of richness towards the south, a part of the mine as yet little explored.

Drifting is being pushed south on the 6th level, and it is proposed at no distant date to cross-cut to the Calumet conglomerate, striking it at a point considerably south of the old conglomerate workings of the Osceola. The general run of the Calumet chutes is towards the north, and there is a strong possibility that there may be one south of the so-called Black Hills chute.

On the so-called west vein, exploration and exploitation have been pushed, and the vein promises well, particularly in small mass and barrel work.

A new pumping outfit has been provided for No. 1 shaft, and is enclosed in a 22x34 building. The pumps and rods in No. 3, together with the ladders, have been placed in the middle of the shaft, which is of double width, and track laying for the new extra skip-road is now in progress. The new engine is expected to be in position by January 1st, 1885.

A laboratory has been built, with furnace and other apparatus, and preparations for assaying the mineral and tailings, both by wet and dry methods, have been made. An office for the mine physician has been built in connection with a building to be used as a hospital; also one double dwelling house.

At the mill, which is in Hancock, on Portage Lake, the main building has been enlarged by an addition 24x26, and a fourth head, of the Ball pattern, built by S. E. Cleaves & Son, added, while the rock bins have been correspondingly increased in size. This head was a necessity, as the large quantity of headings produced kept one head stopped all the time to clean up the mortar. Extensive improvements have been made on the mill dock, by which the coal is unloaded as cheaply and quickly as possible. A small steam hoist is housed on the dock, and is so arranged that hoisting can be conducted from three hatches of a vessel at once.

In the annexed tables, compiled by Mr. Henry Brett, the clerk, a reduction in the cost of ingot produced, as compared with 1882, will be observed. The work done underground is also given in a tabular form, which will be found easy to understand.

The company, in connection with the Tamarack, has purchased the major portion of Sec. 13, T 55 N, R 33 W, and may build a new mill at that point next year. Reference to this is made in the Tamarack report.

UNDERGROUND WORK.

Shafts	868.8 feet.
Winzes and vises	710.6 "
Regular levels	4,846.6 "
Drifts for pillars	51.5 "
Cross cuts	38.1 "
Levels West Vein	51.0 "
Winzes " "	55.9 "
Exploration cross cuts, etc	440.9 "
Total	7,063.4 "

DEPTHS OF SHAFTS TO JANUARY 1ST, 1884.

NO. OF SHAFT.	FEET SUNK.	DEPTH.
1.	88.5	1,119.3
2.	211.4	1,125.0
3.	353.4	1,109.1
4.	215.5	365.0

WORK DONE ON LEVELS TO JANUARY 1ST, 1884.

LEVELS.	NO. OF ADJACENT SHAFT.				FEET.	CROSS CUTS.	WEST VEIN.	
							Levels.	Cross Cuts.
1st.							51.0	440.9
2d.			3		77.8			
3d.								
4th.								
5th.								
6th.				4	349.4			
7th.	1		3	4	508.2	7.9		
8th.			3	4	255.1	30.2		
9th.	1	2	3		732.9			
10th.	1	2	3		983.4			
11th.	1	2	3		1,136.9			
12th.	1	2	3		802.9			

COST SHEET ITEMS.

Tons rock hoisted	208,556;	fathoms, 11,587
“ “ discarded	33,236	“ 1,847
“ “ stamped	175,320	“ 9,740
Which yielded	4,612,675 lbs. of mineral	
“ “	358,100 “ mass and bbl	
Yield per ton rock hoisted	23.83 lbs.	
“ “ fathom of ground broken	429.00 “	
Percentage of mineral and mass in rock hoisted	1.191	
“ “ “ “ stamped	1.417	
Ingots produced	4,256,409 lbs.	
Cost per lb. at mine	10.224 cts.	
Percentage of ingot in mineral	85.$\frac{628}{1000}$	
Stamp rock yield per ton	28.35 lbs. mineral.	
“ “ “ “	24.27 “ ingot.	

GENERAL EXPENSE.

		PER CENT.	AMOUNT.
West Vein Mining		.03534	15,527 91
East “ “	.62541	.59007	259,270 52
Rock Houses		.04991	21,931 88
Transportation		.11795	51,825 41
Stamping		.16083	70,666 07
Incidental		.02146	9,428 01
Surface		.01595	3,730 46
Office		.00849	7,007 42
Total			439,387 68
Exploration, West Vein			4,186 11
Total running expense, as base for calculation			435,201 57
Construction		21,822 01	
Exploration, West Vein		4,186 11	
			26,008 12
Total expenditure in 1883			$461,209 69

AMYGDALOID MINING EXPENSE.

Amount of contracts on mining	$172,186 08
" " " tramming	18,341 85
" " " timbering	12,255 31
" paid captains	4,650 00
" " company account laborers	22,864 40
" " smith, carpenters, et al	6,010 78
" for hoisting and pumping	17,925 83
" " compressor	19,925 23
" " supplies	6,422 04
Total	$280,581 52
Less profit on supplies	21,311 00
Total Amygdaloid mining expense	$259,270 52

AMYGDALOID ROCK HOUSE EXPENSE.

Amount paid overseers	$1,864 00
" " laborers	7,611 00
" for smith	265 85
" " carpenter	476 14
" " other labor	589 42
" " steam power	9,162 78
" " supplies	1,962 69
Total	$21,931 88
Tons of rock treated	208,556
" " sent to mill	175,320

Cost per ton, in cents, 10.51.

TRANSPORTATION EXPENSE.

Paid Mineral Range R. R. ....175,320 at 27½ cts.	$48,212 98
" for snow shoveling	1,647 72
" " car loading	922 89
" " all other labor	416 52
" " supplies	625 30
Total	$51,825 41
" cost per ton in cents	29.56

M. R. R. R. Co. bill, 93 per cent of cost.

COST AND OPERATION OF AIR DRILLS.

Miners or pipes and connections	$1,149 50
Smith, carpenters, laborers and machinists	4,185 75
Wood	10,498 57
Firemen and engineers (4 men)	2,352 19
Other supplies	4,000 20
Total	$22,186 21

There were in use about 30 drilling machines.

STAMPING EXPENSES.

Total number of days run for three heads	879 days 10 hours.
Average run per month	24 " 10 "
Tons of rock stamped	175,320
" " per cord of wood	16,913
Pounds of mineral from rock stamped	4,612,675
Percentage of mineral in rock stamped	1.31
Cost per ton stamping, cents	40.30

Cost of fuel	$33,689 51
" illuminating oil	1,033 90
" lubricating oil	1,087 65
" stamp shoes	163 75
" hardware	194 16
" iron and steel	510 97
" tools and machinery	300 00
" waste	172 32
" packing	505 95
" all other supplies	1,573 93
Supplies total	$39,232 14
Incidentals	195 13
Labor	31,238 80
Total running expense	$70,666 07

WOLVERINE MINE.

I am sorry to be obliged to report that this mine is not being operated by the company. Since the last report, No. 2 shaft has been sunk to the 5th, and No. 1 to the 4th level. The drifts between Nos. 1 and 2 were connected on the 2d, the 3rd and the 4th levels, and these drifts were nearly all driven south to the vicinity of No. 3 shaft.

Down to the 3rd level the ground proved good, and was all beaten away. The block of ground between the third and the fourth levels, however, proved poor, and as the mine was not opened up far enough ahead to warrant a continuance of operations, in view of the prevailing price of copper, the company suspended operations. The mine is now being wrought by the former mining captain, Mr. Wilcox, in company with Mr. John Funkey. These gentlemen have taken the mine in hand for a year, and by that time hope to determine the general run of the copper chutes. I went underground and found the mine pretty well beaten away, with one or two moderately good stopes remaining unbroken south of No. 2.

The men were exploring in the poor block of ground mentioned, and I have since heard that they have found copper in paying quantities close to the foot and hanging-walls. At the time of my visit there was no good showing there.

No. 2 shaft was filled with water in the bottom lift, and I was, of course, unable to see it; but it is said to have cut a good chute of copper. In mechanical details the equipment of the mine is very good. The main hoisting engine operates two drums by means of tooth gears and a pinion, quite an improvement over the old V friction. The ropes from these drums pass over but one sheave at each shaft house. The single sheave is placed with its axis perpendicular to the plane of the two tangents of rope, one from down the shaft, the other from the drum. This method saves one sheave at each shaft, and does away with its friction, both on the axle and in bending the rope.

The underground cars are made of sheet iron, and are hoisted up on an inclined cage to the top of the shaft house, where they are run over a trestle to the rock-house. The rock-house, as at the Copper Falls, is close to the mill. The cars are dumped by the tilting of the terminal section of the track. The prevailing opinion of the Wolverine is that it is a good property, only requiring more money and careful management to make it a paying one.

GENERAL RESULTS FOR 1883.

Surface expense	$ 8,057 05
Mining expense	50,711 10
Stamp-mill expense	28,816 51
Tram-road and rock-house expense	4,410 63
Machinery account expense	5,625 30
General expense, teaming, etc.	2,995 26
Total expense	$100,615 85
Construction of all kinds	18,652 13
Total expenditure, 1883	$119,267 98

No. of feet drifted	1,109.2
“ “ sunk	295.1
“ “ “ winzes	63.7
“ fathoms stamped	2,091.37
“ tons of rock stoped	39,432
“ lbs. of ingot produced	699,622 lbs.
Cost, per ton, of rock stamped, not including construction	$2 55

TAMARACK MINING COMPANY.

This company started a perpendicular shaft on Feb. 10th, 1882, which is designed to reach the Calumet Conglomerate at an estimated depth of 2,240 feet below the surface. Jan. 1., 1884, they had reached a depth of 1,149.5 feet, up to which point the geological section shows the strata pierced. At the present writing, Nov., 1884, the shaft is down 1,800 feet, and indications seem to point to August, 1885, as the probable time for reaching the Calumet.

At a depth of 460 feet a bed of jasper, as the miners call it, overlying an amygdaloid belt, was struck, and in simply the area of the shaft, several tons of mass copper were taken out. This promises to be a most excellent bed, and will unquestionably pay to work. The upper layer of jasper, so called, has been pronounced by Mr. Wheeler, of Washington University, to be argillite.

At a depth of 670 feet the Allouez conglomerate was struck and passed through, but only showed itself to be about two feet thick. Considerable discussion was raised, when the jasper belt was passed through as to whether it was not the Allouez conglomerate; but, as this latter conglomerate outcrops at the rear of the Calumet dam, at Calumet, measurements have shown that, assuming the dip of Hecla No. 4, to be 37 degrees 30 minutes, the second belt passed through must be the Allouez. This Allouez belt is very persistent on the Point, and on it are the Conglomerate Co.'s mine, the Allouez and the Peninsula. Recent diamond drillings at the Pewabic has also cut it on the east of the Pewabic belt.

As to the shaft piercing the Calumet conglomerate, there seems to be not the slightest doubt, as there are levels in the Hecla almost as far down. In regard to the richness, every indication seems to show that it will strike at a rich part. The rich ground of the Hecla has gradually, at an increased depth, veered around towards the south, and is now headed towards the Tamarack. The pay chute which the Osceola worked, and which goes through the Calumet & Hecla's Black Hills, is also pointed towards the Tamarack, and the probability of that point being rich is good.

During the first year the rate of progress was about 41.4 feet per month; the second year, 59.7 feet, and up to date the average for the last year has been 63.9 feet.

The shaft is most substantially timbered from the top down, its inside dimensions being 17 feet 8 inches by 7 feet. It is divided into three compartments, two of which will be used for hoisting and the third for a pump and ladder way.

At present only the middle compartment is used; the bucket is attached by hooks to the wire-rope, which passes through a cross-head fitting in guides. This cross-head is arrested in its motion about 50 from the bottom of the shaft, by two stops in the guides, and from this point, the buckets descend slowly to the bottom. The timbering is kept behind the bottom of the shaft about the same distance to avoid danger from blasting. The surface water, which is the only water in the shaft, serves to keep the timber moist, and so protect them from the dangers, both of dry rot and of fire.

The hoisting plant was described in the last report, and is practically the same. A new 1¼ inch steel rope, and buckets to hold one ton each, have just been procured and will soon be in use. A feed water heater has been connected with the exhaust pipe of the hoisting engine, and effects considerable saving in fuel. The air compressor plant consists of one Clayton and a single Rand machine. These are more than sufficient to supply the necessary air. In time the other half of the Rand compressor will be set up.

The drills used have been Rand No. 4; but lately Rand's new "Slugger" has been introduced with success. This machine does not cushion on the down stroke, and performs, by actual trial day after day, 25 per cent. more work than the plain machine. The ventilation is excellent, one part of the shaft being carried up, by means of a timber frame, high enough above the rest to act as an upcast.

The hoisting arrangements of the copper mines in general is admittedly behind the age, *vide* the use of long inclined shafts; and, if the Tamarack is finally used as a means of output for the lands owned by the company, it will show conclusively the advantage of a vertical lift for material. Already in the Anthracite regions of Pennsylvania, the new breakers are over vertical shafts, and the cost of production is lessened greatly.

As is mentioned in the report of the Osceola, this company has purchased a tract of land on Torch Lake, about seven miles from the shaft, and has surveyed a line of railway to the proposed mill. The mill, if built, will be about 80 feet above the lake, and will have the Hungarian river to depend on during a portion of the year for water. The railroad will run direct to the mill, avoiding the use of an incline with ropes.

CALUMET AND HECLA.

My assistant not being accorded the privilege of entering this mine, I have taken the following description of the plant and underground workings from the *Engineering and Mining Journal.* It was written by the editor of that publication, E. Kirchoff, M. E., after a personal visit of inspection to the mine, and may be accepted as wholly truthful and reliable. I have slightly curtailed it on immaterial points, and have added the official statement of assets and liabilities at the end of the last mine year, 1883–4.

The Calumet & Hecla workings, from their origin and present system of development, may be divided into three sections. Beginning from the north, where the property of the company adjoined that of the Centennial, we have the Calumet with shafts Nos. 5, 4, 3, 2 and 1 in succession ; then follows the Hecla mine, whose shafts, continuing in the same direction, follow one another in rapid succession to Nos. 1, 2, 3 and 4. Farther south, and separated from the ground proper by a stretch of about 3,000 feet of barren ground, are the Black Hills workings, opened by shafts Nos. 10, 11 and 12. In the aggregate, there is a total length of 13,350 feet on the vein, and the company possesses a sufficient area on the hanging-wall side of the vein to mine to any practicable depth. We may state here that surface ownership, in Michigan, carries with it the right of the mineral, and the ground into which the pay chutes of the Calumet and Hecla dip has naturally acquired a value that carries it near the figures held for the choicest city lots in our great cities.

The rich ground of the Calumet and Hecla is distributed in chutes, of which two are distinctly defined, the one, the main chute, between the Hecla shaft No. 4 and the Calumet shaft No. 3, and the other in the South End ground. The main chute does not take a direction parallel with the dip, but makes toward the north, at an angle to it of about 70 degrees, and shows a slight tendency to widen in depth. Calumet shaft No. 5, the latest addition to the openings at the end of the line, is just beginning to enter the chute, at a depth, on the vein, of about 3,000 feet. Then the lode appears to widen, rarely going below 12 feet and reaching upward of 20 feet, and for fully 1,000 feet to near the boundary line gives promise of a productiveness rivaling the more developed parts of the territory. This chute too, shows a northward dip.

It is hardly possible to realize the enormous resources of this long stretch of productive ground. The principal work of extraction is now going on between the 15th and 23d levels, while there are blocked out in the Calumet and Hecla mines twelve additional levels having a back each of 93 feet on the lode that have not been touched. In the Black Hills ground there are nine levels, 99 feet apart on the lode from which not a single ton of ore has been stoped. The rock extracted from the openings has paid the entire cost of sinking, drifting, machinery, track, and equipments, so that the reserves in that mine, which would be famous the world over were it not for the wonders of its neighbor, are a resource of the company for the dim future that has not cost it anything.

To sit down in cold-blood to compute the rock in sight in these mines, would be as unsatisfactory a proceeding as it would be tedious. A rough estimate, based on the most conservative data, makes the total reserves equal to twenty years' work at the present rate of production of 20,000 tons of ingot per annum. For years, the development-work has not only kept pace with the work of extraction, but has gained on it. The policy that has dictated the course thus persistently followed out is one of the advantages of which a trip through the mine fully explains. It makes the work of development entirely independent of that of extraction. The mine being so dry in the lower levels that water must actually be taken down into them for the use of the drillers, and the levels standing for years without a stick of timber in them, there is practically no cost for maintenance, while on the other hand the great advantage of non-interference with the work of extraction is secured, an advantage that more than repays the interest on an investment for development-work that is trifling when it is taken into account that the rock extracted probably more than pays for the direct outlay. A leading thought in laying out the whole plant and equipment of the mine has been to secure a steady output or uninterrupted production. This has led to a duplication of machinery throughout. With a mill crushing more than 1,400 tons of rock a day, and being equipped to increase to 2,200 tons, it is impracticable to provide storage capacity for rock to guard against stoppages of any one part of the vast and intricate equipment. Perhaps the only place where rock could be stored in any quantity would be in the chutes in the mine, and even that is limited by the requirements of the timber-men. When once it has moved in its way out of ground, it must travel on until it is delivered into the stamps without lingering at any point or creating a clogging of the wheels that would be enormously expensive. It goes to the top of the shaft, is dumped into cars, is carried to the rock house, goes through the rock-breakers, is loaded into cars, and is conveyed by a locomotive to the stamp-mill. At the rock-houses, there is of course, storage capacity for two or three days, and probably enough to provide for at the mill to cover the same period; but the leading thought, as we have already pointed out, is steadiness and magnitude of production combined. This of course, has involved a heavy expenditure for plant in many years of preparation during a period when the production was steadily increasing and the mine was steadily returning a heavy profit to its owners. Practically, the work is now done, and the mine, at the end of 1884, will be fully equipped to bring to the surface daily 2,500 tons of rock from a depth of 4,500 feet on the vein. With such an equipment, with a mine, as we shall see farther on, opened out far in advance of a number of years, all paid for out of earnings; with a rock carrying copper enough to bring the cost of its treatment far below any possible decline, it will be readily conceded, by even the most skeptical, that the Calumet and Hecla Company has before it a long career of prosperity.

The vein which the Calumet and Hecla mining company is working dips on an average from 38½ to 39 degrees, showing only comparatively slight variations. Its strike, too, is remarkably uniformly north 35 degrees east, and its thickness, considering the large amount of ground opened, fluctuates but little. It has been known to pinch to three feet and widen out beyond twenty feet, but usually ranges from eight to fourteen feet. Thus far, no indications of any law in the distribution of the copper in the vein has been noticed. South of No. 4 shaft, Hecla, a fault crosses the vein, and a second one has been noticed farther south. They dip toward one another, so that the barren ground may prove to be simply a wedge. Neither of them threw the vein considerably; but they do appear to affect its metalliferous contents, the ground between the two faults apparently forming the limits of the barren ground between the Hecla and the South End territory. The fault near the Hecla shaft, we may here mention, is traceable on the surface by a slight ridge. The conglomerate that forms the vein varies from a fine grain to a very coarse aggregation, but no relation between the character of the conglomerate and the richness of the vein has yet been traced. Often the copper appears to have entirely displaced some constituent of this conglomerate, and massive round boulders of solid copper, sometimes a foot in diameter and fairly uniform in size, are found. We have seen drifts where these boulders were so frequent that the drillers were forced to abandon a number of holes. But usually the constituents of the conglomerate are practically barren, and the copper appears to have mainly displaced its cementing material. Neither in the fine-grained nor in the coarse conglomerate does the copper show a defined tendency to accumulate at the hanging or foot-walls. It is sometimes found near the one, sometimes near the other, and sometimes quite uniformly distributed over the whole vein, and occasionally sheets of copper appear to work in to the hanging-wall. There are, of course, richer and poorer streaks of ground; but the "run of the mine," if we may so term it, the entire amount of rock extracted by removing the whole width of the vein, is very uniform from month to month, and from year to year. It has been noticed in a general way that the rock seems to grow richer in depth, and we have seen in several points in the lowest levels some of the finest faces of copper rock in the mine.

The general average width of the stopes may be put down at a minimum of eight feet, though in the Calumet ground through which we went it is apparently nearer twelve feet. In the Black Hills or South End mine, the vein is wider, averaging nearer fourteen feet. The average yield of the Calumet and Hecla rock is fully 4.5 per cent. of ingot copper, while that of the South End is about 3.5 per cent. of ingot. In the latter territory, however, the increased width fully compensates for lower grade, the product of a running foot of the stopes yielding a larger quantity of metal.

Some time since, a cross-cut was driven into the foot-wall country from a point on the 9th level, north of No. 4 Hecla shaft, its total length being 2,525 feet. At 138 feet, it struck a 19-foot amygdaloid vein; at 458 feet, a 10.5-foot amygdaloid; at 529 feet, a 43.7-foot amygdaloid; at 730 feet, the Osceola amygdaloid, 48.6 feet thick; at 947 feet, a 20-foot amygdaloid bed; at 1,005 feet, a 6-inch calcspar vein; at 1,156 feet, a 10-foot amygdaloid; at 1,490 feet, an 18-foot amygdaloid and a 63-foot conglomerate, the Kearsage vein; at 1,906 feet, a 23-foot amygdaloid bed; and at 2,062 and 2,140 feet respectively, a 25 and a 30-foot amygdaloid bed. Of all these, the Osceola amygdaloid alone seemed promising when cut.

All the workings are in the vein, the shafts being sunk in it. The mine is opened out by drifts 60 feet apart vertically, or 93 feet apart on the dip, in the Calumet and in the Hecla mines; while in the South End mine, the drifts are driven at distances of 65 feet vertically, or about 99 feet on the dip.

All the drifts in the mine are driven seven by seven feet, with power drills, by contract, each drilling gang of four men being paid from $11.50 to $15 per running foot, and being charged with wear of steel, candles, Hercules powder, and supplies. The advance per month of course, varies considerably, averaging from 35 to 55 feet, attaining, however, as much as 93 feet in one case in a drift into the hanging country. There are in use in the mines, on an average, 75 Rand drills, the total equipment being about 100 drills. The system of repairs is an admirable one, being done in the machine shops of the company where duplicate parts are always on hand. Before erecting the repaired drill underground, it is tested on the surface. Experience, we may add, has shown that for the rods, high carbon steel is best. The drifts are throughout equipped of late with steel rails of a comparatively heavy section for a mine road, and the rock is taken to the nearest shaft on tilting-cars with open ends, by trammers, who are furnished supplies. The proximity of shafts to one another makes the average haul a comparatively short one. Sinking is similarly done under contract, two drills generally working together. The price paid ranges from $32 to $36 a foot, the advance made being from 28 to 35 feet a month. The rock is in many cases hoisted to the level above by means of a bucket and a winch, driven by compressed air. These winches have a 7-inch cylinder, and 7-inch stroke, and are built at the machine-shops of the company. Whenever practicable, they are placed between the shaft and the winze nearest it, and are thus made to serve both at the same time. The stoping is done by power, using the winze as a starting-point, and working both ways from it to the shaft, leaving a pillar near the latter, which varies from 10 to 14 feet, and allowing a pillar under the level above of from 6 to 10 feet, according to the character of the roof and the importance of the level as a conveyer of water. Each single lift of the stopes is driven to the boundary of the section, and is followed with the most scrupulous care with timbering that for its massiveness is almost unparalleled in mining. Every foot of rock of the vein is removed, its thickness varying in the slopes of the Calumet mine—every one of which in active operation we visited—from 8 to 18 feet. In most of the stopes, the hanging wall is weak, though to the eye of a visitor it seems to stand very firmly. Those in charge of the mine, however, appear to live up better than any underground captains whose work we have watched to the first rule in timbering, that the time when supports must be put in is before any movement of the roof can take place. The system followed is in a general way to timber up sections of from six to eight sets length on the strike alternating with free chutes, or "mills," through which the rock is thrown to the level below. The timbers, which are from 2½ to 3 feet in diameter on an average, are placed side by side, prop by prop, in many places, and are often in heavy ground provided with from 12 to 14 feet heavy caps or "wall-plates." In some localities, alternate sets are made up of a sill, a series of short props resting upon it, followed by an intermediate sill upon which rests a second line of props abutting against a wall-plate. At some points, the props are not placed in lines immediately following one another on the dip, but alternate with heavy timbers or sills laid one above the other. Altogether, the timbering in the stopes is unparalleled for its strength, and the facts that the large vein is removed without leading to the admixture with the ore of anything but a trifling amount of hanging rock, that the old stopes seem to stand for many years without caving, and that accidents by reason of falls of the roof are almost unknown, are proof that the system thoroughly and successfully deals with the problem. How enormous the pressure is when once a movement, however slight, has set in, was strikingly illustrated in one level when the timbering was being strengthened. At the point in question, a few three-foot props were showing signs of weakness, and one about twelve feet long was beginning to exhibit the destruction of its fibres in the middle of its length by their assuming the form of an S for about an inch. The cost of timbering is, therefore, one of the heaviest items in the expenditure of the mine, being not less than 10 per cent. of the entire mining cost. It practically monopolizes the hoisting shafts of the mine during the day, and requires a large force which works in gangs under a timberman. The rock accumulating in the mills is loaded on cars and trammed to the shafts, where it is dumped into skips of very heavy design, weighing about two tons, and having a capacity of from 3,600 to 3,800 pounds. A good deal of the rock comes down in very heavy masses, and special gangs of men are kept busy traveling through the mine and blasting them, either by laying a cartridge on them and tamping with a little clay, or by drilling holes of suitable depth and firing. Quite frequently the drilling work in levels, shafts, and stopes is seriously impaired by striking nodules of solid copper, which entail the abandonment of the hole.

The system of contracting for stoping is peculiar. The men are paid for the fathom of 216 cubic feet, from $11 to $13; but in many cases the full width of the vein is not counted. Thus, in a 14-foot vein, only 12 feet thickness may be counted, sometimes only 11 feet, according to the character of the rock, the manner in which it comes down, etc. A fathom of 216 cubic feet furnishes from 18 to 19 tons of rock. All the shots in the mine are fired by special gangs of blasters.

Beginning at the north end, we have Calumet shaft No. 5, which has nearly reached the 30th level, where it is just about entering more kindly rock, and it promises to reach the Calumet chute at an early date. It is a wide shaft, 17 feet by 8 feet, and is equipped with two tracks for hoisting, and will in time become one of the principal shafts on the lode. At a distance of 1,115 feet south of it, is No. 4 shaft, opened out to the 32d level, in dimensions of 12 by 8. It is equipped for hoisting with one of the new drums. Distant from it 445 feet is No. 3, opened down to the 32d level and now sinking to the 33d, being a hoisting shaft through which the rock is lifted with the great speed incident to the introduction of the new Leavitt drums. It also is 12 by 8 feet. The distance from Calumet shaft No. 3 to No. 2 is 400 feet. Besides being used for hoisting, it is used principally as a pumping-shaft, there being seven force-pumps, all having a 9-foot stroke, while the diameter of the plunger increases from 7 inches, at the lowest, the 25th-level pump, to 12 inches for the pumps on the 22d, 18th, 14th, 10th, and 6th levels, and to 14 inches for the 3d-level force-pump. The mine makes most of its water between the 14th and 18th levels. It was practically dry at all the lower points visited by us in the beginning of June. The pump is run at about from 5 to 7 strokes a minute, and has been able to handle all the water, even in the spring. A neat arrangement is provided for moving the valve chamber cover, which is lifted by screws until it can be hung in trunnions and run out of the way on an overhead track. Between the shafts 3 and 2, is the man-engine shaft, which passes directly through the stopes, being secured by very heavy timbering. Practically the man-engine shaft fulfills the functions of the usual winze between two shafts, being the starting-point of the stopes for the ground between the 3d and 2d shafts. The man-engine rods are 12 by 12-inch timber, 28¼ inches apart from center to center. At intervals of 300 feet, more or less, their weight is carried by a 2-foot sheave over which a link of chain passes. The lift is 10 feet, and the average speed is six strokes a minute. At intervals, the rods are fitted with small wheels running on a track of suitable length. The man-engine works smoothly and well, and admits of the ascent and descent simultaneously of a shift. No. 1 Calumet shaft is 415 feet from No. 2, and has reached the 32d level. It is still hoisting with the small drums. The distance between the Calumet No. 1 and the Hecla No. 1 shaft is 610 feet, the shaft having gone to the depth of the 32d level. Between these two shafts, is the Hecla man-engine shaft. No. 1 is followed at a distance of 370 feet by No. 2 Hecla shaft, both being equipped for hoisting, to which service Nos. 3 and 4 are also devoted, following one another at a distance of 650 and 405 feet respectively. No. 3 shaft has been sunk to the 25th level, while No. 4 is down to the 9th. Until the recent purchase of the Frue 40 and 80 tracts, these shafts had reached the boundary of the Calumet and Hecla property; but now, of course, they are open to development. In the stretch between the No. 4 and No. 10 Hecla shafts, 3,350 feet in all, there are two shallow shafts of minor importance. There are two faults, one near the former shaft, and the other not far from the latter, which seem to have cut off the ore, the ground between them being practically barren. No. 10 shaft is the first of the South End or the Black Hills territory, where practically a new mine is developing. It is connected on the 5th level by a long drift, recently put through. The South End has three shafts—No. 10, down to the 3d level; No. 11, 800 feet distant from No. 10, is sunk to the 9th level; and No. 12, 480 feet from No. 11, developed to the 8th level; each level being 65 feet vertical lift. Sinking and uprising from different levels is now going on to carry No. 10 to a greater depth. Measured on the 5th level, the distance from the shaft to the south boundary is 400 feet, while the north boundary is 3,700 feet from No. 5 Calumet shaft. Roughly, therefore, the company possesses 13,335 feet in the vein, and as it happens embraces all the known rich part of this conglomerate belt, since efforts to work it in the Osceola territory to the south and in the old Schoolcraft now the Centennial territory in the north have proved failures.

Using the shafts as the points of division in this long stretch of ground, the surface plant may be grouped as follows, beginning again at the north end. Calumet shaft No. 5 has an independent engine, and is equipped with a Guibal fan, 30 feet in diameter. We may mention here, that it is run only a few days in the year, the ventilation in all parts of the mine being excellent. Between No. 5 and No. 4 Calumet is the Calumet rock house, into which all the rock hoisted from Nos. 2, 3, 4, and 5 shafts is conveyed by means of a trestle-work and an endless rope, the drum-house being located between No. 4 and No. 3 shafts. Between No. 3 and No. 2, is the main Calumet hoisting and compressor engine house, of which we shall speak in detail farther on. The gear-house is between Calumet No. 2 and No. 1 shafts, from which the Calumet and Hecla man-engines and pumps are driven. Between Calumet shaft No. 1 and Hecla shaft No. 1 is the Hecla man-engine house. The main machine-shop of both mines, and the locomotive-house, are located between Hecla shafts Nos. 2 and 3, and near it is the Hecla rock-house. Between shafts Nos. 3 and 4, is the Hecla main engine-house, in which the hoisting and compressor plant are located, driven by the "Frontenac" engine. For the South End, an independent hoisting-engine is placed between No. 10 and No. 11 shafts. It will be noted therefore, that the entire plant is duplicated, making both the Calumet and the Hecla mines fully and independently equipped each with a hoisting plant, a pumping-engine, and a man-engine.

The main Calumet engine-house has its chief motor, the "Superior," which was started after our visit, and ran for a couple of weeks very satisfactorily. It was stopped for some slight modifications in the air-pump valves, and will probably be running by the time that these lines reach our readers. It is a compound beam-engine of the Leavitt type, with 70-inch low-pressure cylinder, 40-inch high-pressure steam-cylinder, with 6-foot stroke and Leavitt superheater. Running at a speed of 56 revolutions and with a steam pressure of 135 pounds, it develops an economical horse-power of 2,500, while its ultimate capacity is 4,700 horse-power, when running at 60 revolutions a minute. The engine has two 45-ton fly-wheels 32 feet in diameter. Coupled to the main shaft of the engine, which is 18 maximum and 14 minimum inches in diameter and in all 130 feet long, are two pairs of Rand compressors with 36 and 32-inch cylinders and 5 and 4-foot stroke and four hoisting-drums, two of older type, 10 feet in diameter, 12-foot face, coiling 3,000 feet of rope and driven by V friction-clutch gearing, and two 20-foot Leavitt drums, engaging by means of an Osgood & Blessing hydraulic clutch. They carry 4,000 feet of inch and a quarter rope, and hoist at a speed of 1,080 feet a minute. The hydraulic clutch is so thoroughly under the control of the engineer that it lifts the load gently and without shock, and that the full speed is attained after the skip has been hoisted a few feet without causing the heavy jars that are so destructive to hoisting ropes. We have watched the work of the drum as evidenced by the movement of the skip underground, and are convinced that the hydraulic clutch is far superior to the ordinary contrivances in use at mines. At present, two of the old drums have been removed, and two new ones are to be put in their place, all this work being done while the old drums are running at one side and the pair of new ones on the other side. The plant will finally consist of six Leavitt drums, each capable of carrying 4,000 feet of rope. The drums are grooved, not in sections, as heretofore, but as a whole mounted on their shafts. They weigh 60 tons each. The "Superior" will also drive by wire rope transmission, over 15-foot sheaves, the machinery in the gear-house, to which we shall refer presently. In this main engine-house, there are two reserve engines, one driving the compressors, a Corliss, with 30 by 48 cylinder, running 50 revolutions a minute, and the second, at the other end, driving the drums, which is a horizontal Leavitt engine, 40 by 60-inch cylinder, running at a speed of 50 revolutions. This engine-house, we are convinced, has no rival for its size in this country, in the magnitude and beauty of its machinery and the enormous work it is called upon to perform. Considerable trouble has been experienced here, as well as at other points, in the surface plant of the mine, with a material for the foundations that proved very unsatisfactory after being in use for some time. It is a sandstone, quarried near the railroad leading to the mill, which, when tested, showed itself capable of resisting a crushing strain of 5,500 pounds per square inch. After remaining in the foundation for some time, however, it begins to exhibit a shrinkage nearly equal to that of pine wood, and a number of cracks appear in the stone. This has made it necessary to take out the foundation in many cases, and to replace it with concrete and a capping of Cape Ann granite. With these changes, and with the very heavy bed-plates used throughout in all the machinery, the plant possesses a solidity more than equal to any tax upon its permanency. Steam is furnished to the engines in the Calumet engine-house by three boilers designed by Mr. Leavitt, and built by Messrs. Kendall & Roberts, of Cambridgeport, Mass. They are covered with a mixture of sawdust and plaster of Paris, which has proved to be an excellent and cheap non-conductor. Near the boiler-house is a large coal-shed.

Between Calumet shafts Nos. 2 and 1 is the gear-house, containing the machinery for driving the two man-engines and pumps. At present, it is run by a Porter-Allen engine, with 18-inch cylinder and 3-foot stroke, running at a speed of 192 revolutions. In the future, this engine will be merely a reserve, the machinery to be driven from the "Superior" by wire rope transmission. The sheave at the gear-house is 15 feet in diameter, and will make 133⅓ revolutions a minute. A clutch is provided on the sheave shaft to throw it in and out of gear. From the main Porter-Allen engine shaft, provided with a clutch, the power is transmitted by a belt to a second main shaft, from which, by cog-gearing, it is transmitted to the four shafts to which the cranks of the two man-engines and pumps are attached. By heavy connecting-rods, the motion is transmitted to rockers, the two Hecla rockers being mounted on hollow shafts 32 inches in diameter and 40 feet long, made of gun-iron, in order to carry them into line with the shafts. From the rockers, wooden rods transmit the power to the bobs at the shafts, to which the pump and man-engine rods are connected. Every one of the four shafts is provided with Robertson clutches to throw it in and out of gear. The entire plant is of exceedingly massive and substantial character, gun-iron castings being the material used for the bobs.

The Hecla engine-house, containing the machinery for the Hecla mine principally, is, like the others, a fine brick structure, and roomier than the Calumet building. The main engine, recently completed, is the "Frontenac," a Leavitt compound engine of the latest type, embodying all the modifications of detail, suggested by the experience with the others. The Frontenac has a 27¾-inch high pressure cylinder, a 48-inch low pressure cylinder, a 6-foot stroke and a 25-foot fly-wheel weighing 61,300 pounds. It was started early in June, and, driven for the first time, accomplished the feat of running without a load at a uniform speed of 60 revolutions a minute, with a steam pressure of 110 pounds, and throttle wide open. The engine drives the four hoisting-drums of the Hecla end, each 24 feet in diameter and coiling 3,000 feet of rope. These drums are of more recent pattern than those displaced by the Leavitt drums at the Calumet end, but still do not, in elegance of design and efficiency, compare with the latter. They are driven by V friction-gearing, the shaft being bodily lifted until it engages. Until quite recently, these drums were driven by a 30 by 72-inch Corliss engine, which will now be held as a reserve. The Hecla mine has one pair of 28 by 48-inch Rand air-compressors, until recently driven by a Corliss engine, but now to be run by the "Frontenac." We understand they will be displaced by larger compressors of the same make. The "Frontenac" will also drive the machinery in the small but very well-appointed machine and repair shop close by, in which all the current repairs in machinery and in the rock-drills are made.

The rock as hoisted from the mine is taken automatically, by an endless hemp rope, driven by a small-engine, on a trestle-track, which overcomes any difficulties due to heavy-snow falls, to the rock-house of the Calumet and to that of the Hecla. At these rock-houses, the rock is reduced by rock-breakers to a size not exceeding that of a fist. The largest pieces are broken by a Hodge & Christie hammer and then put through a very large rock-breaker. The run of the mine is passed through rock-breakers of ordinary size, of which there are seven at the Calumet rock-house and five at the Hecla rock-house. The South End mine is not yet equipped in this manner, the rock being dumped until wanted, and thus at the present time acting as a reserve. The Calumet rock-house machinery is driven by a small horizontal engine, the rock being delivered into chutes from which it drops into the railroad cars. At the Hecla rock-house the bins are of greater capacity and are capable of storing fully two days' supply. The rock-house machinery will, in the future, be driven by the Superior and the Frontenac respectively. Now, nearly all the run of the mine, a good deal of the fine, and all the coarse, is put through the crushers, which could be more steadily supplied with material requiring actual work, if the rock as it comes from the mine were dumped on a grizzly screen. It is likely that at no distant date this part of the plant will undergo the remodeling that it needs.

The entire surface plant is supplied with water by the water-works, situate at a pond in the hanging country of the lode at some distance from it. The water-works are equipped with a splendid small Leavitt compound pumping-engine, having an 11¾ inch high pressure, and a 24 inch low pressure cylinder, 4 foot stroke and 17 inch plungers, with a capacity, running at 37 revolutions, of 5 million gallons. As a reserve, there is a Worthington pumping engine, with 14 and 24 inch cylinders, 3 foot stroke, and 20 inch plungers. The water is furnished through a 16 inch main to a stand pipe, 80 feet high, located near the Calumet engine house. The mine pumps deliver into the pond, and no trouble from scarcity of water has been experienced even in the driest seasons or in winter.

It will be seen, therefore, from this hasty sketch, that the surface plant is on a magnificent scale, and is so arranged that its equipment is for two mines independently, and that throughout there are engines in reserve fully capable of carrying on the work at an hour's notice. One point that might possibly strike unfavorably those mining engineers conversant with the handling of enormous quantities of material in European and American collieries is, that the rock is hoisted in skips, by single ropes, without taking advantage of the weight of an empty descending skip, to counterbalance that of the one ascending. This might be particularly objected to because the dead weight of the skip seems disproportionately great as compared with the load carried. The leading cause for this apparent neglect of an important source of economy is, we take it, the fact that the dimensions of the old slopes are too small to admit of double track. That this is the case, is indicated by the fact that the latest shaft sunk, No. 5, is considerably larger than the others, and is equipped with a double track.

Another point that might lead to a diversity of opinion is the general plan of concentrating the machinery plant, while scattering the work of hoisting over a long line through a number of slopes, thus necessitating the use of long lines of wire rope above ground. It might be urged that it would be better to concentrate the hoisting in one or two main slopes or shafts, with cages, casting off the skips, and using rolling stock that is filled at the "mill" underground, and is dumped at the rock house in the immediate vicinity of the main shaft. The advantages would be a reduction in the dead weight and a saving in the cost and maintenance of ropes. Aside from the fact that this would involve a greater expense for underground tramming, and that the great number of levels from which hoisting goes on would make the constant changes troublesome, there is one great leading fact that operates against the centralization plan, and its principal advantage is the saving of the cost of maintenance of a number of shafts instead of one. That fact is, that in the Calumet and Hecla mines enormous quantities of timber must go into the mine. We have therefore two of transportation, if we may so term it, one of rock out of the mines and one in an opposite direction into the slopes, which are in danger of constantly conflicting with one another. First of all, it would not be good practice to haul sticks of timber three or four feet in diameter and from 10 to 20 feet long, for any distance, when it can be done cheaper on the surface than underground. Therefore a number of shafts in close proximity to one another becomes an economy instead of a waste. Then hoisting rock must be practically suspended while the timber is going in, and although the weight of the latter is not nearly equal to that of the former, its unwieldly character calls for so much time in handling that it occupies nearly all the shafts during the day, while the night is devoted to hoisting. Nor would it be possible to use a number of slopes simply for lowering timber while one shaft was steadily employed on rock, because transportation of the levels would be seriously interfered with by the movement of timber. The system employed is therefore peculiarly adapted to local circumstances, and the employment of large engines is rendered more economical still by the fact that they have a steady, uniform minimum load in driving the air-compressors and other machinery.

The mine is connected with the mill by a railroad equipped with five twenty-ton locomotives, kept in repair at the machine shops of the company. The cars, with drop-bottoms, carry an average load of 4.2 tons, and are made up into trains averaging 40 cars, a train leaving the mines every hour, approximately. The grade is a heavy one, making a maximum of about 190 feet down to the mill, and has a number of pretty sharp curves. It reaches the head of an incline at a distance of four miles. At the incline the cars are uncoupled in series of five, and are drawn to the incline by an auxiliary stationary engine. The rope runs over a sheave, the full cars carrying the empties up, together with any cars loaded with timber, coal, or machinery that may be shipped to the mine, and in winter, with the product of the mineral of the mill, for transhipment at the mine, via the Mineral Range Railroad, to the smelting works at Hancock. The railroad, for the greater part of the way, passes through woodlands, and is without cuts, so as to prevent any drifting of snow. It is possible to keep it clear with a snow-plow, pushed by the weight of a heavy rock train behind it. At the foot of the incline the cars are carried by rope drawn by a special engine to the bins of the two mills, the Calumet on the right and the Hecla mill on the left, both being on the bank of Torch Lake, accessible to water transportation in the summer.

The mills are now in process of reconstruction on a scale commensurate with the capacity of the mine. When completed, the plant contemplated will be based upon the crushing capacity of ten Leavitt stamps, with one in reserve at each of the mills, making twelve in all. These ten stamps, each of which will have an average crushing capacity of 225 tons a day, will represent an annual demand for ore of 675,000 tons, equivalent to an output per annum of fully 30,000 tons of ingot on the basis of 4.5 per cent rock. The average of the rock in 1883 was slightly above this. As at the mine, this expansion of the plant is to be carried on while the existing equipment is keeping up its present average record of 2,100 tons per month of mineral. At present there are in the Calumet mill two Leavitt and three Ball stamps, and in the Hecla mill two Leavitt and one Ball head, one of the latter class being removed to make way for an additional Leavitt stamp. At the Hecla mill an extension is now building, and the foundations will be put in, in course of the summer, for three additional Leavitt stamps, for which a part of the machinery is on the ground; while in the Calumet mill the three Ball heads will be similarly displaced. With the present equipment of four Leavitt heads, having a capacity of 225 tons a day, and four Ball heads, averaging 165 tons per day, approximately, the mill treated an average of 1,411 tons a day during the month of May, making 2,265 tons of mineral during the month. The Ball heads have been repeatedly described, and need no special mention now. The Leavitt heads will be referred to in detail in a paper by Mr. Coggin, manager of the mill, before the American Society of Mechanical Engineers. Mr. Coggin has made their works a special study, and has devised an ingenious method of determining the velocity of the piston at any part of the stroke, which, in connection with a thorough system of indicator diagrams, has been a valuable guide in carrying the machine to its present high standard of efficiency.

The valve gear has been somewhat modified, and other changes have been made that have all contributed to reach the saving of over 39 per cent in steam consumption, as compared with the Ball stamp. One of the Leavitt stamps has reached a duty of 234 tons a day. The Leavitt stamps are run with a steam pressure of 90 pounds, cutting off at about two tenths, with a receiver pressure of 55 pounds, making 90 blows a minute. The velocity of the piston is, for the greater part of the blow, about 17 feet, the weight of the shoe being, when new, 600 pounds. It wears down to make half its weight in from 5½ to six days. The rock is crushed through a 3-16 inch screen, made of steel plate, being the "common" steel of the Crescent Steel-works. The new plan contemplates the erection for each head of four sets of washing machinery for each stamp, each set consisting of four Coggin separators, the principle of which was described in a recent paper before the American Institute of Mining Engineers. In the Hecla mill there will be 168 Collum jigs for dressing and 96 for rejigging; while the Calumet mill will have 112 machines for dressing and 64 for rejigging. In each mill, there will be six 5-stamp batteries of the California pattern, 750-pound stamps and 6-inch drop, which will be used for restamping and rewashing the waste sands. For the treatment of slimes, the ordinary round rotating buddle, with water-spray discharge, has proved more efficient than the Evans buddle generally used in Lake Superior copper dressing works.

As in all other parts of the enormous plant, the stamp-mills are equipped with duplicate machinery, so that there will be no possibility for stoppage of work through break-downs, however unimportant. Accordingly there are two driving-engines, one the "Erie" and the other the "Wabeek," the latter having formerly served as the hoisting-engine on one of the Hecla shafts. The Erie is both a driving and a pumping engine, being of the compound Leavitt vertical type. It has an 11½ inch high-pressure cylinder, a 24-inch low-pressure cylinder, and 4½-foot stroke. With 100 pounds steam, and running at a speed of 46½ revolutions, it develops 200 horse power. With two 16½-inch plungers, and 23 inch buckets, it has a pumping capacity of 10,000,000 gallons. It drives all the washing machinery in the stamp-mills and tail-houses by wire rope transmission, the main rope, which runs on a splendid sheave 13 feet in diameter, running at a speed of about a mile a minute. The "Wabeek" will be the main driving engine, being just in the course of erection after some alterations. It, also, is a Leavitt compound engine, with 22¾-inch high pressure and 38-inch low-pressure cylinders and 5-foot stroke, and when running at 45 revolutions will develop over 600 horse-power. The main pumping engine is the Ontario, a Leavitt compound engine with 17¼-inch high-pressure cylinder, 36-inch low-pressure cylinder, and 5-foot stroke. Running at a speed of from 20 to 30 revolutions a minute, with steam at a pressure of 100 pounds, it is capable of pumping 20,000,000 gallons of water a day. As a reserve, the water works possess a Brown 18 by 48 horizontal engine, geared to a pump having a capacity of 20,000,000 gallons a day, when running at 25 revolutions a minute, the pump having a 6-foot stroke and 36-inch plunger. This plant is furnished with steam by a nest of "Elephant" boilers, 30 inches in diameter and 44 feet long. A new boiler, built by the Dickson Manufacturing Company, of Scranton, is to be put in, having a 90-inch shell, being 34 feet long, and with a heating surface of 2,800 square feet. It is rated at about 700 horse power. For the Calumet stamp-mill, there is a plant of "Elephant" boilers, while the Hecla mine is furnished with steam by four locomotive boilers, 6 feet 8 inches in diameter and 32 feet long, with 1,800 square feet of heating surface in each. The mill has a fire engine and fire service, a machine shop and a cooper-shop. It is accessible by boats drawing 13 feet of water, and is the main receiving station for coal and machinery, and the principal shipping point by lake of "mineral." The work is thoroughly systematized.

This brief sketch may serve to convey some idea of the magnitude of the operations of the greatest and most successful metalliferous mine in the United States, and may aid in forming some conception of the brilliant future still before it. For the richness and magnitude of its ore body, for developed reserves, for completeness and efficiency of its mining and crushing plant, the high quality of its product, the low cost of production, and its exceptional financial position, it stands unrivaled among the mining enterprises of the world. The credit for having carried the mine to its present point is due to the concerted efforts of Prof. A. Agassiz, the President, and his staff at the mine, Mr. J. N. Wright, Agent; Mr. J. Duncan, Assistant Superintendent; captains Hoatson, Daniels, and Wills, in charge of the underground work; Messrs. L. S. Woodbury and J. Ramsey, the former mechanical engineer of the Hecla mine in charge of the machine-shop, and the latter in charge of the Calumet machinery; Mr. F. G. Coggin, superintendent of the stamp-mills; and captain West, formerly of the Coast Survey, who has systematized the topographical work and the underground surveying of the property of the company. Mr. E. D. Leavitt, Jr., of Cambridgeport, Massachusetts, is consulting engineer.

STATEMENT OF ASSETS AND LIABILITIES APRIL 30TH, 1884.

Assets.		
Cash at Boston	$103,504 44	
Cash at Mine	10,371 78	
Copper—20,811,399 lbs., at 12c	2,497,367 88	
Bills receivable	2,134 24	
		$2,613,378 34
Liabilities.		
Drafts in transitu	$21,018 77	
Notes payable	374,000 00	
Accounts payable	170,581 30	
Loans	220,000 00	
		$784,600 07
Excess of Assets		$1,827,778 27

ISLE ROYALE MINE.

The Isle Royale mine is owned by a party of men in the East who do not desire it at present to be actively operated, and, although the property is good, but little is being done, and the mine is full of water up to the first level.

During the past year the agent, Mr. Graham Pope, has done a small amount of exploring on the vein, and has made a most excellent showing. At the north end of the Isle Royale vein, he has sunk a shaft forty feet, which has passed through considerable small mass copper in calcite. If this shaft shows good copper for a depth of 100 feet, Mr. Pope will unwater the mine to the sixth level and start exploring that block of ground lying between shafts No. 5 and 8. All this ground was abandoned years ago as poor; the drifts had all been run close to the foot, and this proving poor, the ground was not touched.

The Isle Royale lode is a hard, firm amygdaloid, carrying a large amount of mass and barrel work. There are occasionally found bunches of epidote and of calcite. The mine has yielded during her career 375 lbs. of copper to the fathom of ground broken.

GRAND PORTAGE MINE.

The low price of copper, and the disinclination of the owners to put more money into the mine at present, has caused a cessation of work in this very promising property.

I visited the two mines, the east and west lodes, last January, and found that the veins were looking well at all points; large quantities of stamp rock and horns of barrel work were visible on every side.

A new boiler had been provided at the hoisting house on the west lode, and work was progressing in a satisfactory manner.

During the year 1882–1883, 151½ feet of sinking was done in the shafts; in the winzes 320¼ feet. The drifting amounted to 1,367 feet. From stopes there were removed 2,184 fathoms of ground.

I was unable to get any definite figures of the work done at the mill. The general product was 40 tons of mineral per month—a very good showing. The rock averaged 2 per cent. of mineral, according to the statement of the company, which would make the amount stamped per day about 40 tons. The mineral ran high in copper, 80 per cent. being the record—the highest on the Lake, the Osceola excepted.

GENERAL RESULTS, 1883.

Number of fathoms stoped	2,184
Cost of stoping per fathom	$17 87
Number of feet sunk, shafts	151½
Cost of shaft per foot	$28 52

Number of feet sunk, winzes	320¼
Cost of winzes per foot	$12 18
Number of feet drifted	1,367
Cost of drifts per foot	$16 10

All of the above figures are on the basis of hand labor alone, no machines being used.

Captain Berg has charge of the property.

HURON MINE.

During 1883, and till nearly the present time, the Huron plant has been practically under construction. It is now producing copper regularly, and the mining people of Lake Superior have great confidence in it. The Huron has ten shafts; of these, Nos. 10, 8 and 6 are in active use. They do not all run in planes parallel to each other, shafts Nos. 10 and 8 slightly converging. No. 10 shaft is the most southerly and is operated by a distinct engine; the rock hoisted is at present teamed to a chute near No. 8. Shafts Nos. 6 and 8 are run by a vertical engine operating two drums with V friction gear. The rock from Nos. 6 and 8 is dumped on the rock-house floor, where it is sorted and the large pieces crushed in rock-breakers. The fine rock is run into cars which are pushed by hand power to two chutes near the shaft-house. From these the rock is dumped into the mill-cars.

The railroad leading to the mill from the chute near No. 6 is about a quarter of a mile in length in a straight line, that from No. 8 joining it a short distance below No. 6 chute. The railroad is provided with a small hoisting engine, at its end near No. 6, and the cars run by gravity to the mill, trailing the rope after them. At the mill they are hoisted to the top of the bins, over a trestle incline, by a small engine. The empty cars are pulled back up the track by the engine at the head of the long incline, the cars for No. 8 being left at the switch and hauled thence by horses. At the top of the mill the cars, which are end-dumping, discharge their contents on an A shaped ridge, one-half going to each bin, of which last there is one for each head.

During the past year there has been added, since the agent's report, one new boiler for the engine at 6 and 8. There has also been put in one half of a duplex compressor, built by the Portage Lake Foundry and Machine Works. The mine has, in addition, a duplex compressor, built by Rob't. Allison, Port Carbon, Pa.

At the mill extensive additions have been made. A second head has been put in and two hydraulic separators and fourteen wooden-bodied washers added, while on the north end of the mill a very compact slime room has been built. The slime from the two heads runs into two settlers, whence they go to two Evans tables. The heads from these tables run together and are elevated by means of two sand pumps, and then discharged over a third table. The tailings from these three tables are run off to waste with the sands. The water for the mill was formerly pumped from the dam by a power-pump operated by a wire rope ; this has been superseded by a duplex Worthington pump of sufficient capacity to supply both heads.

ANNUAL REPORT OF HURON COPPER MINING COMPANY.

Herewith, we hand you the annual report of the doings of the company the past year, ending December 31, 1883, also the agent's report, giving an account of the workings at the mine, both on surface and underground, with prospects for the future, etc. Also the usual statements of receipts and expenditures, and of assets and liabilities, the latter of which we are sorry to say, still predominates; but every dollar spent has been so much to increase the value of the property of the company, and was for actual necessities to enable our business to be carried on in a legitimate and successful manner.

With the second head of stamps in good working order, there is no question but what, with prospects as they now are at the mine, and with copper at even a little less than at present prices, a fair paying profit can be made, and the mine be enabled to take its place in the list of dividend paying mines.

Since our agent wrote his report in January, the mine has shown a gradual improvement, and is now looking better than ever before. Work is now progressing favorably at the mill on the second head of stamps, and we hope that in May it will be in good working order and largely adding to our product, which, with a fair price for copper, is all that seems necessary to carry the Huron Mine to a successful operation.

Captain Johnson Vivian still has charge of the mine, and is entitled to great credit for the skillful manner in which the property has been handled and brought to its present promising condition.

Below we give in detail, the expenditure at the lake as well as in Boston, for the past year.

EXPENSES.

Mining expense, labor, etc.	$33,340	30
Sinking 259$\frac{2}{10}$ feet shafts, at $19.50	5,161	31
Sinking 204$\frac{9}{10}$ feet winzes, at $14.50	2,952	35
Cross-cutting 261$\frac{2}{10}$ feet at $9.88	2,582	35
Drifting, 2,537$\frac{2}{10}$ feet at $12.36	31,384	51
Stoping, 2,152$\frac{5}{10}$ fathoms, at $14.31	30,822	58
Labor on surface	1,096	75
Supplies and fuel	7,645	61
Stamping expense and hauling rock to *old mill* and Pewabic	7,593	53
New stamp mill, cost of	31,434	16
Tram road, from mine to mill	2,597	26

Stamping expense at new mill on 15,312 tons rock	$15,465 57
New houses	5,429 71
Repairing houses and additions to old houses	2,895 04
Surface expense, teaming, supplies, etc	9,018 19
Tram road expense, on 15,312 tons	1,289 30
Rock-house expense, breaking, selecting and delivering to tram-road 22,233 tons*	5,402 46
General expense of all kinds	7,001 39
Or a total of	$203,112 37
To which is to be added, smelting, freight, insurance, brokerage, interest, etc., paid in Boston amounting to	23,776 61
Or a grand total for the year of	$226,888 98

The total product was 870,875 lbs. mineral, which gave a yield of 82$\frac{70}{100}$ per cent. ingot, or 720,213 lbs.

The yield per ton of rock was 2$\frac{11}{100}$ per cent. mineral.

For the directors,

D. L. DEMMON, *Treasurer.*

AGENT'S REPORT

OFFICE OF THE HURON COPPER MINING COMPANY,
HOUGHTON, Mich., Jan. 10th, 1884.

D. L. DEMMON, ESQ., *Treasurer.*

DEAR SIR—With the close of the year's business, it becomes my duty to report the amount of work done, also to refer to the present condition of the mine, as well as its prospects for the future, etc. With this end in view, I beg leave to submit the following remarks, and tabular statements, which latter show, in detail, the cost of each department of the mine for the year ending December 31st, 1883. Herewith, also find an inventory of supplies, tools, and machinery on hand, together with map of the underground works which have been carefully surveyed by Mr. L. G. Emerson, M. E.

Surface Work.—In this department, the following improvements have been made. No. 10 shaft and rock house, which were damaged by fire last summer, have been rebuilt, the cost of which was covered by insurance. One dwelling house for the foreman, carpenter, and a boiler house, in which two boilers are located, to supply steam for the air compressor, 2,900 feet of railroad from Nos. 6 and 8 shafts to the mill, have been constructed, and an engine placed at the head for operating the same. Owing to the scarcity of feed-water for the boilers, of which the mine could not furnish sufficient quantity at this time of the year, we have laid 2,400 feet of pipe from the stamp-mill to the mine, through which, with a pump attached to the mill engine, water is forced to the compressor and hoisting engines, all of which is working satisfactorily, and has doubtless settled the feed-water question for many years.

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* Part of this was stamped at old mill and Pewabic.

Stamp Mill.—The mill was started stamping rock on the first of August last, and has worked very satisfactorily ever since. We expect to have No. 2 head in operation about the 15th of May next.

Machinery.—Nothing of a serious nature has happened in this department, and everything considered, all has worked fairly well. It will be necessary to add to our present machinery the coming spring another air compressor, four drills, and a boiler, which will be all we shall require in this department until we get the third head of stamps, which the mine already shows evidence of wanting in the near future.

Mining Work.—No. 6 shaft has been sunk from the 10th to the 11th level, and the bottom level opened 85 feet, all of which is unproductive. The 10th level has been extended south 155 feet, and north of the shaft 310 feet. The former, and about 200 feet of the latter, are not showing anything of value; but the last 110 feet of opening are showing well in stamp and barrel copper. The 9th level has been extended north 293 feet. The first 150 feet from shaft are rather lean; in fact, a large portion of it may be called poor; but the balance of this opening is showing good paying ground, which is about 20 feet in width.

The 7th level has been extended north 277 feet. About one-third of this opening is not rich enough to pay; but the balance, or 66 per cent. of it, is through a piece of lode that contains all grades of mineral, from 18 to 25 feet in width which will pay well to stope.

No. 8 shaft has been sunk from a point 30 feet below the 10th to the 11th level. The lode at this point is large, and shows a fair amount of stamp and barrel work. The bottom level has been opened 300 feet, the greatest portion of which will pay to stope. The 10th level has been extended north 45 feet, and south 28.5 feet. The lode in the former is poor; in the latter opening there is some valuable stoping ground. The 9th level has been extended south 280 feet, one hundred feet of which passed through copper ground that extends from foot to the hanging wall, and is not less than 25 feet in width. The balance of this opening is not showing anything of value.

No. 10 shaft has been sunk from the 6th to a point below the 7th level. The lode for the whole distance shows copper in paying quantities; and the same may be said of the lode in the 7th level, which has been opened south 37 feet, and north of this shaft 80 feet.

Prospects for 1884.—If the mine continues as it is now showing, and the openings are kept well ahead of the stopes, etc., the present product can be maintained, and after the new head is started, a yield of from 125 to 130 tons per month will be made, which will return a good fair profit.

My assistants, Captain Thomas H. Odgers, and Captain Joseph Snell, have faithfully discharged the duties of their respective positions.

I am yours respectfully,
J. Vivian, *Agent.*

Cash Receipts and Expenditures of the Huron Copper Mining Company, for year 1883.

Cash on hand January 1, 1883	$2,425 94
" received from sale of copper, 647,787 lbs., at $15\frac{688}{1000}$ cents	101,624 08
" received from assessments	47,140 00
" " " sale of forfeited stock	813 39
" " " interest	704 05
" " " loans	332,954 53
	$485,661 99

CONTRA.

Cash paid mine agent's drafts	$205,262 99
" " loans	249,724 49
" " interest, expense, taxes, insurance, etc	8,600 68
" " smelting and freight	9,541 09
" " copper charges and brokerage	6,338 89
" " forfeited stock	299 70
Cash on hand December 31, 1883	5,894 91
	$485,661 99

Assets and Liabilities of the Huron Mining Company, January 1, 1884.

ASSETS.

Cash on hand January 1, 1884	$5,894 91
Copper on hand, 143,963 lbs. @ 14⅞ cents	21,415 52
Supplies at mine	31,610 41
Assessment of December 5th, unpaid	32,860 00
	$91,780 84

LIABILITIES.

Due for loans	$104,730 04
" " drafts	35,623 38
" " smelting	2,722 00
" " freight	484 95
" " forfeited stock	647,85
" " liabilities at mine	21,036 92
	$165,245 14
Less assets as above	91,780 84
Balance liabilities, January 1, 1884	$73,464 30

ATLANTIC MINE.

During the year 1883, the Atlantic stamped about 6,000 tons more rock than the previous year, but although the cost per ton was reduced, the low price of copper diminished the earnings. The sinking amounted to 89.7 feet, and the drifting to 3,064 feet.

At the time of my visit No. 3 shaft was down to the 14th level. The 13th level was through from No. 3 to No. 4, and hoisting was in progress from that level through No. 4. At No. 2 shaft they are hoisting from the 10th level. No work is being done on No. 1 shaft. Some of the drifts from No. 2 have passed through and beyond No. 1, but there is a pillar at the bottom which will not be removed till the necessity for more rock requires it.

At the rock house the "grizzleys" on which the rock was dumped, have been removed, it having been found that large quantities of flat trap went through between the bars and fell into the rock-bins. As it now is, all the rock is looked over, and considerably more trap is removed. One new breaker has been added.

The fifth head of stamps has been added to the mill and is now in working order. An addition to the east side of the mill has also been built, in which the extra head and adjuncts have been placed. The head is a fifteen inch cylinder, wooden frame, of the Ball pattern. It was made in piecemeal at various foundries, and put up by the mill machinists.

This head stamps about 180 tons of rock a day. The wash consists of fourteen iron-bodied Collum washers, built by S. E. Cleaves & Son. These washers are all single machines, that is, each machine has its own driving crank and counter shaft. This method is much preferred now as any accident to a belt stops but one washer, and if it be desired to stop a machine to skim the bed, it can be done without affecting its neighbor. A mill floor with single iron machines make a much finer showing than with the old-fashioned wooden machines.

The use of iron-bodied machines is becoming more and more extended on the lake. The Conglomerate is supplied with them, the Central has a few, and all the new machines of the Calumet and Hecla are iron-bodied. The Allouez third head has iron-washers. The Peninsula is supplied throughout with them, and now the Atlantic fifth head has them. In the Anthracite regions iron-bodied washers are used to jig the slate from the coal, but the bodies are made in segments and bolted together. Those in use on the lake have the body cast in one piece. The merit of this invention is due to Mr. Will S. Cleaves and Mr. James Melton.

The Coggin separators, which I have alluded to as being used in all the new mills, are also used here with great success. This separator was got up by Mr. Coggin, of the Calumet & Hecla mill, assisted by Mr. Rickard. It gives better preparation of the material for the washers, with a less amount of water. A description of the apparatus will be found in the Transactions of the American Institute of Mining Engineers.

The following Annual Report for the year 1883 tells its own story:

ANNUAL REPORT OF THE ATLANTIC MINING COMPANY.

The directors present the following statement of operations during the year 1883:

The production of mineral was 3,857,258 pounds, which yielded 69$\frac{53}{100}$ per cent., or 2,682,197 pounds of refined copper. The shipments to market during the year amounted to 2,670,189 pounds, for which, estimating the amount not sold at the close of the year at 14½ cents per pound, there has been realized an average price of 15 cents per pound.

The following is a summary of the year's business:

PRODUCTION.

Copper sold............2,385,585 lbs. at 15$\frac{08}{100}$ cents.... ..		$359,720 17
Copper unsold......... 284,604 lbs. at 14½ cents.........		41,267 58
2,670,189 lbs. average 15 cents.....		$400,987 75
Copper at smelting works, December 31, 1882....	$40,373 06	
Copper at smelting works, December 31, 1883, 300,387 pounds, valued at 12 cents, net	$36,036 44	
		4,326 62
Net value of product of 1883..........................		$396,661 13
Add balance of interest account.......................		2,131 87
		$398,793 00

COSTS.

Working expenses at mine as per clerk's tables..	$281,956 70	
Smelting, freight, and all other expenses.......	55,012 62	
Net operating expenses................................		336,969 32
Showing a mining profit in 1883 of....................		$61,823 68
There has been expended for purchase of 160 acres of land.............................	$2,000 00	
And for construction account as per detailed statement hereafter........................	9,115 32	
		11,115 32
Leaving a net gain for the year of....................		$50,708 36
The surplus from 1882, after disposal of copper on hand and payment of dividend, was............................		253,516 47
Making a net surplus, December 31, 1883...		$304,224 83

as shown in detail in the annexed statement of assets and liabilities. From which a dividend of $1 per share ($40,000) was paid February 1, 1884.

There is no change to note in the condition or prospects of the mine. It has been worked to the capacity of the stamp-mill and the production has slightly increased. The decline of more than 2½ cents per pound in the market value of copper from the prices of last year has seriously diminished our profits, although the costs have been somewhat reduced. The usual statements of the work performed, and its costs, are appended, also our agent's report, and to these we refer for further information.

Joseph E. Gay,
Chas. J. Starr,
John J. Crane,
Geo. A. Hoyt,
R. H. Rickard,
John Stanton,
Directors.

AGENT'S REPORT.

Atlantic Mine, L. S., Mich.,
January 1st, 1884.

John Stanton, Esq.,
Treasurer Atlantic Mining Co., New York.

Dear Sir—Allow me to present to you my report of the work done at Atlantic mine for the year 1883:

No. 2 shaft is in good working order to the 9th level. This level has been extended north 365 feet. The lode has been variable in richness and very bunchy; the copper is sometimes found in the foot and at other times in the hanging-wall. At the point where the transverse vein intersects the lode in this level, we found several small pieces of copper, and as the transverse looked encouraging we drifted east 25 feet into it, but it became very poor when the drift passed beyond the lode.

A large amount of ground has been opened and stoped in the 7th level north of No. 2 shaft, which has yielded fair results.

The 5th level has been driven about 100 feet beyond the line of No. 1 shaft and there is about 25 feet of ground standing between the level and the bottom of the shaft (which is at the third level), and can be raised through and connected with the shaft when desirable. Some very good rock and barrel work were taken from this back in the vicinity of No. 1. The entire length of this level is 3,200 feet, and it is the longest in the mine.

No. 3 shaft has been sunk from the 12th to the 13th level, and put in operation. The 13th level has been extended north and south, and the openings have yielded very good rock. The lode at the 12th level, north of No. 3, has yielded a quantity of good rock. This level has been extended south past No. 4 shaft and the stoping ground between Nos. 3 and 4 shafts removed, excepting the necessary pillars.

The 11th level, north of No. 3 shaft, is still in very good ground. A peculiar feature of the mine is, that where the richest portions of the lode are found, the hanging-wall is unreliable and we are compelled to leave large blocks of very rich ground for pillars.

The 10th level has been extended north beyond No. 2 shaft, and has intersected the transverse vein, which is very poor.

No. 4 shaft has been put in working order from the 11th to the 12th level. Drifting and stoping have been carried on in the 7th, 8th, 9th, 10th, 11th and 12th levels south of this shaft with fair results, but we have to leave large blocks of good ground to support the hanging-wall.

The number of feet sunk is	89.7
" " drifted on the lode is	3,064
" " " " cross cut east on transverse is	25.7
" of cubic fathoms stoped is	10,422$\frac{36}{216}$
The total number of cubic fathoms broken in openings and stopes is	11,163$\frac{205}{216}$

You will see by the map, which is filled out to date, that quite a number of pillars are left for the protection of the mine. As the mine attains depth, the hanging-wall becomes weaker, and in addition to the pillars a large quantity of timber is required. There were used for this purpose last year, 20,000 lineal feet of hemlock timber to keep the mine in good condition for future operations.

An additional pump has been put in the pump (or No. 3) shaft at the 4th level to assist the one at the 3d level in the spring and fall, at which seasons the flow of water from the upper parts of the mine is too great for the pump at the 3d level, and the excess has run to the 7th level. The pump will effect quite a saving in fuel at these seasons.

All the pumps and skip roads are in good condition.

STAMP MILL.

The mill has stamped and treated 195,669 tons of rock, at a cost of 35$\frac{35}{100}$ cents per ton. The rock has yielded 19$\frac{713}{1000}$ pounds of mineral per ton, and 13$\frac{708}{2000}$ pounds of refined copper per ton.

Mr. Wm. Evans, superintendent of the mill, has been making some improvements in the washing machinery, which I think will increase the yield of the rock, by saving some copper that has heretofore been escaping.

RAILROAD.

The railroad, locomotives and rolling stock are in very fair condition. There has been transported over the road 195,669 tons of rock, and 464 tons of freight from dock to mine, at a cost of 7$\frac{15}{100}$ cents per ton. We have put in one-quarter of a mile of new steel rails, 1,030 new ties, and 1,800 feet of snow fence, which accounts for the increased cost per ton of transportation.

MACHINERY AND BUILDINGS.

The engines, compressor and rock-house machinery are all in very good condition. Quite a number of our dwelling-houses are old, and annually require a great deal of repairs. I think it advisable to expend about $2,000 a year in erecting new houses to take the place of the log houses that are getting into bad condition.

CONSTRUCTION.

We have constructed an addition to the dock 358 feet long and 24 feet wide; a machine shop at the mine 30x40 feet (attached to the carpenter shop), which contains the following tools: A lathe, planer, machine drill, bolt cutter, circular and band saws, wood lathe, and a fan blower to supply blast to the forges in the smith shop. The tools and machinery are driven by a 10x15 engine, which is supplied with steam from the pumping engine boilers. A new dwelling-house 18x28 feet has also been erected.

In conclusion I refer you to tables, statements and section of mine platted to date, by H. A. Van Tassel, clerk, and commend to your favorable notice the various officers of the mine.

Yours truly,

WM. TONKIN, Agent.

ONTONAGON COUNTY MINES.

There is very little to report concerning the copper mining interests of Ontonagon County, which may not more properly claim a place in the report for 1884 than in this. Only six mines report having made any copper in 1883, against nine which reported a considerably larger product the previous year—385 tons, 1,365 pounds refined copper in 1883, as compared with 463 tons, 1,948 pounds in 1882. The mines from which a product was reported for 1883, are the Mass, National, Ridge, Belt, Minesota and Ogima—the Nonesuch, Adventure and Aztec having dropped out of the list.

I did not visit the Ontonagon mines, for the reason that I knew but little was doing, and that there could be but few facts to collect and publish bearing upon the operations for 1883 which would be of interest to the public, the stamp-mill at the Belt mines, as will readily be inferred by reference to the table of products, not having been completed and put into operation in time to very materially enhance the output of mineral in that year. The mill was completed, however, and put into operation early in 1884, and was kept running till late in the fall, when it was shut down until such time as the mine can be placed in condition to furnish sufficient rock to keep it running. With this end in view, what is known as the Great Western part of the property, has been unwatered, and will be opened up during the winter to an extent sufficient to give ample stoping ground, in connection with the other workings, to keep the mill in steady operation, when once again it may be started. The work thus far done, including the erection of its very complete stamp-works, has absorbed the entire amount of working capital originally provided by the company, and an assessment has been called to meet the further requirements of the work of development. Although the results thus far attained have not equalled the anticipations of shareholders, it is hardly to be expected that the English owners will hesitate about coming forward with sufficient additional means to complete the work so fairly begun.

The Mass mine, which is credited with the great bulk of the copper made in Ontonagon County last year, is now being wrought by Mr. Chenowyth, former clerk for the company, under an agreement whereby he agrees to keep the expenditures with the limit of earnings. How well he may succeed will be a proper subject for discussion in the report which is to follow this.

At the Ridge the mine continues to be wrought on tribute, the work, however, being confined to the upper levels which were long ago abandoned by the company.

The Nonesuch produced no copper in 1883, the process by which the syndicate of owners expected to be able to extract and save 5 per cent. of ingot from the rack, having proved an utter failure. Late this fall, however, the owners determined to test the mine for silver, it being well known that a belt of rock lying along the foot-wall, and from 4 to 6 feet in thickness, was more or less charged with that mineral. Accordingly cross-cuts were made into this vein on four different levels, and the rock as taken out packed in sacks and sent away for a practical test, of the result of which I have not been informed, though I have it from the most reliable authority that the vein rock thus obtained shows native silver in apparent plentiful quantity.

Until Ontonagon County shall have been more fully embraced within the railway system of the Upper Peninsula, it will be idle to expect more than a merely partial development of her mineral resources. That these are great, almost beyond comparison, there is every reason to believe. With a railroad traversing the copper range, affording facilities for its development which do not now exist, we may as certainly expect Ontonagon County to take rank with her sister counties in the production of copper as she is reasonably certain to rival the Marquette and Menominee ranges in the magnitude of the product of her iron ore fields now in rapid progress of development.

DIVIDENDS.

The following is a statement of dividends paid to shareholders by the copper mines of Michigan in 1883:

Atlantic	$80,000
Calumet and Hecla	2,000,000
Central	60,000
Osceola	200,000
Quincy	380,000

The total of dividends paid by Michigan copper mines to May 1, 1884, is as follows:

Calumet and Hecla	$24,850,000 00
Quincy	3,890,000 00
Cliff	2,280,000 00
Minesota	1,750,000 00
Central	1,710,000 00
Osceola	1,035,000 00
Pewabic	400,000 00
Franklin	320,000 00
National	300,000 00
Atlantic	260,000 00
Ossipee	130,000 00
Ridge	100,000 00
Copper Falls	100,000 00
Hilton	15,000 00
Total	$37,140,000 00

IRON MINES.

As stated in my letter to the governor, the very full report of my predecessor, in which he described the condition of all the principal iron mines as they existed up to a late date in 1883, leaves very little, if anything, to be said or written concerning them in connection with that year's operations, other than can be found in the statistical table. There was a very material falling off in the output, as compared with the previous year, owing to the general depression in the iron trade, and a consequent decline in prices, which led to the closing down of nearly all the smaller mines, and some large ones which produce only low grade or non-bessemer ores — while, with but one or two exceptions, were any of those which continued in operation wrought to their full capacity. No new mines of importance have been developed in either Marquette or Menominee County—indeed, there was, and still is, very little inducement to exploration, in view of the fact that the mines already opened are of abundant capacity to supply all the ore for which there is likely to be a demand, at remunerative prices, in the near future. This is shown by the fact that, with many of the smaller mines not working at all, and some of the larger ones working largely reduced forces, the product of 1884 will be considerably larger than that of last year, and could easily have been made to equal the magnificent output of 1882 had there been a demand for the ore.

As intimated, it is not my purpose to review the mines of the Marquette and Menominee ranges in detail, but make them the subject of an exhaustive paper in my report for the present year. There is, however, a new, if not newly discovered, ore field now in progress of development, a brief description of which, together with a detailed statement of the work thus far accomplished, properly belongs right here. I allude to the

AGOGEEBIC IRON RANGE,

which, so far as known, extends from the lake of that name, in a nearly due west direction, to the Montreal River, which is the boundary line between Michigan and Wisconsin. This range is wholly within the limits of Ontonagon County, that part of the same formation west of Montreal river being known as the Montreal range; it is not improbable that it will also be found east of Lake Agogeebic, from whence it may be traced to a connection with the ore beds or veins in the southwest part of Marquette County, the opinions of geologists to the contrary notwithstanding. As yet, however, nothing of positive value has been found on that side of the lake, though a shaft has been sunk in section 12, town 43, range 42, to a considerable depth in a lean magnetic ore, and which, at the time of my visit to the range (August), was being continued in the hope of finding something better. The developments were just sufficiently encouraging to operate as an incentive to further work in the hope of better results, and a diamond drill was talked of in connection with subsequent exploration.

On the other side of the lake the first really promising exploration reached in going west on the wagon road from Gillis' Landing, are those of the

AGOGEEBIC IRON AND MANUFACTURING CO.

On the north half of the southeast quarter of section 21, town 47, range 43, where considerable test-pitting has been done, with indefinite results, no ore of marketable value having been found in any of the pits. But, at a point 1,070 feet west and 250 feet south of the east quarter post, a shaft had been sunk to a depth of 85 feet—through 6 feet of drift, covering a loose ledge of mixed quartzite, jasper and ore, below which the ground is a ferruginous quartzite, containing bunches of jasper, and occasional seams of hard, rich hematite. From the bottom of this shaft cross-cuts were being driven north and south, the heading of the one to the north, at the time of my visit, being 18 feet from the shaft and in ground of precisely the same character. The south cross-cut was in 25 feet, and showed very much more ore of good quality—enough of it, in fact, to warrant the belief that the main deposit could not be very far off. Samples taken from this drift a few days later, and shown to me on my way back from the Sunday Lake region by a different route, indicated a marked improvement, both in the quality and quantity of the ore then being encountered, and I would not be surprised to hear at any time that a workable deposit of clean ore had been struck between the shaft and the quartzite, which last outcrops about 300 feet to the south, and in a bluff 75 to 100 feet high. The shaft is well and substantially timbered, and large enough to admit of a skip track, in addition to the pump and ladder-way, in case a workable deposit is found, of which last there seems scarcely a reasonable doubt. At present the shaft is provided with a small portable hoisting engine of the Rochester pattern, a No. 6 Knowles pump, and a fan, operated by a diminutive upright engine, for ventilating purposes.

THE SUMMIT EXPLORING, MINING, AND MANUFACTURING CO.

is at work on the south half of the northeast quarter of section 21, the explorations being the same as those of the Agogeebic Co., under the superintendence of Capt. James Tobin, who has had long and valuable experience in such work. The explorations made prior to his advent were of a most desultory character, and better calculated to confuse than assist him in laying out a plan for the practical exploration of the property. None of the shafts or pits had been timbered in such a way as to hold back the drift and thus enable him to see the ground at the bottom, and he was, therefore, without anything to guide him other than he would have had in the absence of any previous work having been done. Capt. Tobin's explorations consist of what is designated as No. 4 test shaft, located 400 feet north and 1,400 west of the east quarter post of the tract, which was sunk through 10 feet of drift, 13 feet of loose slate and ore, and 25 feet of mixed ore into gray slate, where the work was stopped. No. 5 pit, 200 feet east of No. 4, shows 35 feet of mixed ore and 25 feet of slate. These pits show the formation to be very flat, with only a slight dip to the northwest. At No. 5 considerable trouble was experienced from a large flow of water, a horse whim, with barrel attachment and a spring-pole pump being found inadequate to the task of reducing it. A short distance north of Nos. 4 and 5, and about midway between them, measuring from east to west, a pit has been sunk to some depth in mixed ore, associated with finely laminated slate and jasper. Considerable work has been done both to the east and west of this last mentioned pit, but without satisfactory result. Due north from No. 4, 450 feet, is No. 6 test shaft, which at the time of my visit, had been sunk through 7 feet of surface drift, and 13 feet of loose ledge. Thirty feet south is a pit which shows a vein of good ore 5 feet in thickness, which the management expects to cut by a cross-drift from the bottom of No. 6, when a sufficient depth shall have been reached, the dip being in that direction. Owing to the flatness of the formation and the low wet ground in which the pits are located, explorations cannot be carried on with any great amount of satisfaction to the management, and, unless it be concluded to sink a deep shaft, and cross-cut the entire formation from its bottom, it would seem that a diamond drill will have to be called into requisition. It is just possible that the slate underlying the loose ledge may be a capping to an otherwise regular formation. The five-foot vein spoken of is all that has yet been developed of any possible value, unless it be the slate which, if not too closely jointed, might be found valuable for manufacturing purposes. It does not follow, however, that workable deposits of merchantable ore may not be found on the tract; the ore bearing formation is a very wide one, and the explorations thus far made are not of sufficient extent to exhaust the probabilities, to say nothing of the possibilities, connected with the property.

Both the last mentioned tracts are covered with a heavy growth of hardwood—principally maple and birch—while the soil is such as to promise the largest returns to the agriculturist. Indeed, a more beautiful forest of thrifty maple, birch, elm and basswood, with an occasional grove of pines, than that which stretches away from Lake Agogeebic to the state line on the west and south, and to Lake Superior on the north, is not to be found anywhere. Aside from its mineral resources, the wealth of the region, having exclusive reference to its timber, and agricultural adaptabilities, can scarcely be over-estimated. The streams, the waters of which flow northward into Lake Superior, will furnish an abundance of power for manufacturing purposes, which can be utilized at trifling expense. The falls of the Presque Isle river are but a short distance from the Agogeebic and Summit locations, and will prove a most valuable adjunct to those properties, should the explorations now in progress result in the development of workable ore deposits, as I have faith to believe they will. The power, in the shape of compressed air, could be conveyed to the mines at a modicum of the cost entailed at other points where it has been similarly utilized; the surrounding and almost impenetrable forests will supply the fuel to keep going the fires of a number of blast-furnaces for many years after their inception; and, altogether, I regard the region as one upon which nature has lavished its most bountiful favors.

GOLD AND SILVER.

The same company was, at the time my notes were taken, sinking a shaft in a belt of dark chloritic schistose rock, which is highly silicious, and charged with free quartz and iron pyrites, and which is shown by analyses to be rich in gold and silver. This shaft is located in the north half of the northeast quarter of section 28, town 47, range 43, 1,100 feet west and 330 feet south of the northeast corner of the section. The metalliferous belt dips at an angle of about 75 degrees to the south, under what at first appeared to be a regular hanging, but which is really a part of the vein or belt, which at this point is at least 60 feet wide. The shaft, which at the time of my visit had reached a depth of about 15 feet, showed two seams of the same rock largely decomposed, which is apparently much more heavily charged with the precious metals—the one next to the hanging being from 6 to 8 inches and the other from 8 to 12 inches wide, and both in conformity wiih the hanging. Specimens taken from a depth of 14 feet in the shaft show considerable silver-lead, which is considered a favorable indication. The shaft is located in the north side of a hill (which rises to an elevation of 125 feet above drainage), about 150 feet west of where the vein outcrops, and beyond which it has been traced eastwardly, by test-pits and trenches, a distance of 450 feet. It is the intention of the company to give the vein a thorough test, to which determination they have been encouraged by the assays herewith appended, and which were made from samples taken from across the bottom of the shaft at a depth of only 7 feet:

No. Sample.	Silver.	Gold.	Total.
1	None.	None.	None.
2	$10.00	None.	$10.00
3	8.50	Trace.	8.50
4	11.00	7.00	18.00
5	7.50	12.00	19.50
6	7.70	30.00	37.70
7	7.70	36.50	44.20
8	15.00	40.00	55.00
9	10.00	34.00	44.00
10	12.00	30,00	42.00
11	15.00	40 00	55.00
Average	$9.50	$20.80	$30.30

This is certainly a good showing, and, considering the great width of the metalliferous belt, the expectation of a paying mine seems almost absolutely certain to be realized. Of course, it will require a practical test to settle the question beyond doubt, the assays, favorable as they are, being by no means conclusive proof that the vein carries the precious metals in paying quantities; they can only be accepted as the very best evidence possible upon which to found such a belief, and as such they have already served the purpose of attracting the favorable attention of experts and capitalists whose research promises to be most thorough and conclusive.

On the south half of the southeast quarter of section 10, town 47, range 45, there is another silver bearing vein or lode, in which the Hon. Richard Guenther, of Oshkosh, Wis., has, or did have, an option for a lease, Geo. M. Wakefield, Esq., of the same place being owner of the fee. On the south line of the section an opening has been made in a belt of fine-grained, laminated, grayish-white sandstone, from 3 to 7 feet in width, and which is inclosed between well defined walls of quartzite and jasper, the latter being the underlying rock. The vein rock shows well up in silver, as is evidenced by the following assays made by different and disinterested parties:

SAMPLES NO. 1.	
No. 1	$ 8.00
2	215.00
3	10.00
4	6.00
5	trace.
6	183.00
7	trace.
8	15.00
9	175.00
Average	$68.00

SAMPLES NO. 2.	
No. 1	$ 9.00
2	5.50
3	36.50
4	trace.
5	125.00
6	trace.
7	132.00
Average	$44.00

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The trend of the formation is very nearly from east to west, the variation from that course being just enough to carry the vein over upon section 14, where it is again to be seen a short distance south of the south line of section 11, upon which last section the dip, which is about 55 degrees to the north, will carry it at no very great depth. There is abundant reason for the belief that this vein will be found to contain silver in paying quantities, a question which will be definitely settled at no very distant day.

Reverting again to the iron ore deposits of the Agogeebic range, it is proper to remark that the first really good show of ore encountered in going west from the lake of the same name is in section 10, town 47, range 45. In this assertion no disparagement is meant of the properties on section 21-47-43, and where the conditions are most favorable to the development of good mines—only that the explorations being much further advanced at the one location decides in its favor the uncertainty associated with the other. In the one instance, the work has not progressed beyond the exploratory stage; in the other the existence of large deposits of high grade ore are not only a fixed fact, but they have been sufficiently developed to warrant the commencement of actual mining operations on a large scale, so soon as the completion of the railroad to Ashland furnishes an outlet for their product.

These mines, for such they can now legitimately be called, are about one mile east of Sunday Lake, and were first explored by Geo. S. Fay, for himself and others, in 1881. Finding nothing of positive value, he surrendered his option, and was succeeded by Neil Gillis, who did some work with like result the following year. In 1883, Moore & Vaughn took the option, and after finding the ore transferred all their right, title and interest to the Agogeebic Iron Co., of which Geo. M. Wakefield, Esq., of Oshkosh, is the moving spirit. This company had sunk a number of test-pits, and was working day and night shifts in a couple of substantially timbered shafts located in the hanging-wall, and from the bottom of which cross-cuts were to be made into the ore. The trend of the formation is nearly east and west, but, unlike that on section 21-47-43, the dip is to the north. No. 1 test-pit, which is located 175 feet east of the west line, was sunk to a depth of 50 feet—through 20 feet of drift covering and 30 feet of ore—a drift south from the bottom showing 22 feet of clean, soft, blue ore, with occasional bunches of hard, steely hematite. Here, as elsewhere, the hanging is banded ore and jasper, with quartzite in the foot. No. 2 test-pit, 200 feet east of No. 1, is in the foot-wall, and is down 40 feet. A cross-cut north struck the ore in 6 feet, in which it continued 16 feet to the hanging, the ore being of the same uniform good quality as that found in No. 1. These pits are on the west half of the south-west quarter, and constitute what, we believe, is to be known as the Ascherman mine. No. 1 pit, on the east half of the same quarter section, is located 1,410 feet east and 743 feet south of the west quarter post, is 38 feet deep, and shows 17 feet of the same soft blue ore found on the west half of the tract. North of this they have test-pitted the ground a distance of 200 feet across the formation, without finding anything but banded ore and jasper. No. 3 is one of the timbered shafts referred to, and is located on the east half of the southwest quarter, 130 feet west and 975 feet south of the center quarter post. It is in the hanging, and at the time of my visit they were just commencing to cross-cut south from a depth of 65 feet, expecting to cut the ore by 30 feet of drift. No. 1 shaft, also well-timbered, with plenty of room for skip, pump, and ladder ways, is on the west half of the southeast quarter, 400 feet east of No. 3, and, like the latter, is in the hanging. Here, too, it is the intention to cross-cut south to the ore, at a depth of about 75 feet from the surface. That these cross-cuts will reveal an ore body of some magnitude is made certain by the developments further west, where the formation is precisely the same. Some idea of the regularity of the formation can be gathered from the fact that after the first two pits were bottomed a bee-line was staked out to the east, and in all subsequent pits put down in that direction, the ore was found within 100 feet of it; and it should be remarked that the explorations show that the ore extends nearly the entire length of the section, from east to west. No reasonable doubt can be entertained as to the development of several prolific mines in this particular locality; it is enough to say of the section 10 deposit, that its length is all that could be desired, while what it may lack in width will be more than offset by the greater economy with which mining operations can be prosecuted on that very account. The ore is low in phosphorus, and averages high in metallic iron, being fully equal in all respects to the best bessemer ores of the Menominee range, though not quite up to the best red speculars of the Marquette district.

The company was employing a force of about 20 men, under the superintendence of Capt. James Tobin, had comfortable and commodious camps, and everything in good shape for the prosecution of preparatory work. If the work has been continued under the present intelligent management, there can be no reason why these mines should not be in condition for a large output as soon as they are supplied with transportation facilities, which, I am assured, will not be later than July next.

On the north half of the southeast quarter of section 9, and immediately adjoining the property last referred to, Messrs. C. E. Wright and Frank Brotherton have made some very promising developments. A cross-cut from the bottom of a shaft located about 150 feet west of the east line of their tract, and which was sunk to a depth of 35 feet shows 16 feet of clean blue hematite, analyses of which gave 66 and 64 per cent. of metallic iron with only .026 of phosphorus. About 1,000 feet further west a second shaft was sunk through 27 feet of drift and into 12 feet of ore, when cross-cuts were made north and south revealing 30 feet of vein, all clean ore, analyses of which gave from 58 to 63 per cent metallic iron, and from .014 to .033 phosphorus. A third shaft some 200 feet east of the one last mentioned was also bottomed in ore, an analysis of which gave 66 per cent. iron. At the time of my visit nothing was being done at this point, the owners of the lease being content to await the completion of the railroad then building before entering upon the work of regular and active mining.

Hart and Shores, of Ashland, at the time of my trip, were engaged in exploring the northeast quarter of section 14, town 47, range 46, and had just bottomed a pit in soft blue hematite; not enough work had been done, however, to determine either the extent or value of the deposit. The men in charge claimed to have found good ore in several other pits and shafts, one of which had been sunk to a depth of 50 feet, and cross-cuts made north and south in 25 feet of soft blue hematite. Judging from the dumps, I was much inclined to believe their assertions, but the pits and shafts being full of water it was impossible to verify their statements by personal examination.

THE COLBY IRON COMPANY.

Was operating on section 15, town 47, range 46, where they had one shaft down 45 feet in a hard blue hematite, from the bottom of which a cross-cut had been made, showing 17 feet width of vein. This shaft is located about the center of the east half of the northwest quarter of the section, and the vein or deposit had been developed over a length of about 150 feet. Some 200 feet south of this deposit, and separated from it by a belt of red slate, is what is known as the south vein, which so far as known carries a width of about 16 feet, and has been traced by test pits and trenches nearly, if not quite half a mile to the westward, where it is found on section 16. Analyses of the ore from these two veins gave the following results:

SOUTH VEIN.		NORTH VEIN.	
Metallic iron	50.43	Metallic iron	62.52
Manganese	15.40	Manganese	.80
Phosphorus	.089	Phosphorus	.059
Silica	.60	Silica	2.69

Since my visit the railroad (Milwaukee, Lake Shore & Western) has been completed to this mine, and about 1,000 tons of ore were shipped to Erie for a practical test, the result of which I have not been informed. I learn, however, that it is the intention to have the mine in condition for a very considerable output next summer, by the middle of which the completion of the railroad to Ashland, where ore piers are in course of erection, will give all the prospective new mines on this range ample shipping facilities.

On the south half of the northeast quarter of section 16, 47–46, considerable exploratory work was done a couple of years ago by the Cambria Iron Company. These explorations cover a length of about 400 feet on the extension of the south vein of section 15, the pits, trenches, shafts, and cross-cuts showing, it is claimed, 35 feet width of ore. The pits being partially caved in, and no one at work, myself and assistant could only form an opinion of the property from the character of the dumps. The ore appears to be a limonite carrying a very considerable percentage of manganese, as shown by an analysis of a specimen taken from the dump:—metallic iron 58.28; manganese 9.01; phosphorus .056; silica 1.14. The Cambria Iron Company having surrendered its option, the lease was taken by the Colby Iron Company under purchase from the original lessees, Messrs. Maitland, Sedgwick, and others.

IRONTON IRON COMPANY.

The next explorations in regular order are those on section 17, same town and range. The original explorations were made by the Cambria Iron Company, the Ironton Company subsequently becoming owner of the leasehold. The workings consist of a shaft located about 60 rods north of the south line of the section, on the southeast quarter, which was sunk to a depth of about 70 feet. A cross-cut north is said to have cut 28 feet of ore, which the dump shows to be of very good quality. In another shaft of the same depth 175 feet further east, a cross-cut shows 38 feet of the same kind of ore. From a point in the cross-cut 28 feet from the shaft, a drift was driven west 40 feet in clean ore. An analysis of the ore from these explorations gave 63.24 metallic iron, 4.17 silica, and .092 phosphorus.

On the southwest quarter of the same section, the lease of which is held by H. H. Stafford, Esq., a good quality of limonite has been exposed in a series of pits extending over a length of 600 feet on the formation. At the west end, however, the vein or lens was found to be only about 6 feet in width, but whether this fact was due to a mere contraction of the vein, or indicated the end of a lens, could not be determined from the amount of work done.

Passing by the southeast quarter of section 18, where we found three pits, showing good ore in the dumps, we came to the southwest quarter of section 24, 47–47, where Moore, Barden & Vaughn were at work, and had sunk several pits, one of which showed 6½ feet of ore outcropping under two feet of surface drift. Next we reached the location under lease to

THE VAUGHN IRON COMPANY,

Which embraces the southeast quarter of section 23, same town and range. Here the explorations consist of two rows of test pits, extending over a length of 700 feet on the formation. These pits show a vein of ore apparently from 20 to 30 feet in width for the length stated, and that the ore is of good quality is shown by an analysis which gave 63.45 metallic iron, and only .028 of phosphorus.

THE AURORA IRON COMPANY

Hold the option for a lease on the east half of the southeast quarter of the same section, where a number of pits have been sunk in ore. One of these pits was sunk 22 feet in the ore, and from the bottom a cross-cut 19 feet in length failed to discover the hanging, while still another drift from a shaft 200 feet further east, and of the same depth, struck the hanging in 22 feet. The ore is a fine grained blue hematite, an analysis of which gave 64.89 metallic iron, 1.24 silica and .028 phosphorus.

One of the most promising finds in this locality is that made by A. L. Norrie, Esq., who, by sinking and drifting, has shown up what appears to be a very large deposit of first-class bessemer ore; but there being no one on the location we were not able to take any notes which would enable us to describe the workings in detail. Suffice it to say that the Norrie is generally regarded as by far the most promising deposit yet developed on this new range.

THE ASHLAND EXPLORING AND MINING COMPANY

Was at work on the north half of the northwest quarter of section 27–47–47, their first pit being located about 600 feet south of the line, and showing 7 feet of clean ore in the bottom. About 600 feet east, a pit was put down through 30 feet of surface drift and into 15 feet of ore; a cross-cut was then made from the bottom and shows 21 feet of ore between the walls. Another shaft was then put down about 170 feet east of the first mentioned pit and struck the ore at a depth of 58 feet, into which they had gone 8 feet at the time of our visit. The ore exposed in these pits and shafts is a soft blue hematite, giving by analysis 65.51 metallic iron, 2 52 silica, and .046 phosphorus.

This brings us to the state line where the formation crosses into Wisconsin, and where some valuable developments have been made; but these of course do not come within the province of this report.

It is yet too early to venture a positive prediction as to the probable extent of the ore deposits of this new range. It may not be amiss to remark, however, that one of the encouraging features of the range, and one calculated to give it preference in point of economy in working, is its great regularity. It will be either regularly good or uniformly poor; judging from the developments thus far made it is much more likely to prove the first. But of all this, I will be much better prepared to speak intelligently in my next and last report, before which time the work of exploration will have been carried far enough forward to enable one to form a more accurate and decided opinion as to the probable future of this new ore field.

TABLE Showing the Amount of Land Plaster and of Calcined Plaster, produced in Michigan, for each year since 1866, and previous years:

YEARS.	Land Plaster. Tons.	Stucco — Barrels. 300 lbs. each.
For years previous to 1866	100,000	80,000
1866	14,604	....
1867	17,439	....
1868	28,837	34,966
1869	29,996	41,187
1870	31,437	46,179
1871	41,126	48,685
1872	43,536	59,767
1873	44,972	82,453
1874	39,126	82,449
1875	27,019	61,120
1876	39,131	64,386
1877	40,000	55,000
1878	40,000	48,346
1879	43,658	50,800
1880	49,570	106,004
1881	33,178	112,813
1882	37,821	135,655
1883	33,225	201,133
Total	734,675	1,234,943

SALT.

The following table shows the number of barrels of the various grades of salt inspected since the establishment of State Salt Inspection in 1869:

Years.	Grades of Salt in Barrels.				Total for each year in Barrels.
	Fine.	Packers.	Solar.	Second quality.	
1869	513,989	12,918	15,264	19,117	560,818
1870	568,326	17,869	15,507	19,650	621,350
1871	655,923	14,677	37,645	19,930	728,175
1872	672,034	11,110	21,461	19,876	724,481
1873	746,702	23,671	32,267	20,706	823,346
1874	960,757	20,090	29,391	16,741	1,028,979
1875	1,027,886	10,233	24,336	19,410	1,081,865
1876	1,402,410	14,233	24,418	21,668	1,462,729
1877	1,590,841	20,389	22,949	26,818	1,960,997
1878	1,770,361	19,367	33,541	32,615	1,855,884
1879	1,997,350	15,441	18,020	27,029	2,058,040
1880	2,598,037	16,691	22,237	48,623	2,676,588
1881	2,673,910	13,885	9,683	52,821	2,750,299
1882	2,928,552	17,208	31,335	60,222	3,037,317
1883	2,828,987	15,424	16,735	33,596	2,894,742

Previous to 1869 the salt production of the State was as follows:

Years.	No. of Bbls.	Years.	No. of Bbls.
1860	4,000	1865	477,200
1861	125,000	1866	407,077
1862	243,000	1867	474,721
1863	466,356	1868	555,690
1864	529,073		

SLATE.

Though there is little to report concerning the slate beds of Baraga county, in the way of further development, it affords me pleasure to be able to state that there is a fair prospect of several new quarries being added to that industry in the very near future. The extent of the deposits being already widely known, the superior quality of the slates produced by the Michigan Slate Company at its quarries on Huron Bay, are serving to attract the attention of capitalists to this most inviting field for the investment of capital in the development of what can hardly prove otherwise than a permanently lucrative industry. The Huron Bay quarries have been steadily wrought during the past two years, during all of which time there has been an eager demand for their product at remunerative prices; indeed, had the management been able to multiply the number of squares produced by 100, it would yet not have been able to supply the demand for slate roofing, such is the popularity of the slates produced. The Michigan Company made in 1883, about 10,000 squares of roofing slates, though up to the present time the main effort has been directed towards the opening of new ground, and the placing of the quarries in position for a large future production. New openings have been made, and there is now a much larger amount of slate in sight than ever before in the history of slate mining on Lake Superior. The output for 1884 will exceed that of last year, and the management confidently anticipate being able to more than double their product in 1885.

Work on what is now the Michigan Slate Company's quarries was originally commenced in 1872, and spasmodically continued until 1878, in which year the Huron Bay Company, (the affairs of which had been wofully mismanaged,) and the Clinton Company (for the want of the necessary capital)—these being the pioneer companies—were both forced into liquidation. The first-named company spent a large amount of money in surface improvements, which included a tram-way from its quarry to Huron Bay, five miles in length, and a substantial dock for the shipment of its product. As in the inauguration of nearly all new enterprises, serious mistakes were made, some of which were, perhaps, excusable, while others can only be credited to the ignorance of those having the work in charge. These errors are now to be seen in the necessity for the removal of the large amount of waste thrown out of the original openings, and which is found to be in the way of new ones which must necessarily be made in order that the work may be carried on economically, and so that the greater one of mistaking the cleavage for the bedding may be rectified. Indeed, it is questionable whether the Michigan Slate Company—successor to the Huron, Clinton and Superior Companies—would not have found itself in better position to wrestle successfully with the many difficulties always encountered in the prosecution of new enterprises, had no previous effort at development ever been made, since nearly all the obstacles it has had to contend with were, seemingly, placed in its way by its predecessor with a degree of accuracy that could not have been improved upon had that been the sole aim and purpose of the preceding management. However, most of the blunders referred to have been corrected, though at the cost of a good deal of time, labor, and money, and the Michigan Company's quarry, at the time of my visit (July) was beginning to assume a workable shape. The present owners commenced work in the belt just south of the old Clinton pit, where an opening 200 feet in length has been made on the south slope of the anticlinal wave, the synclinal showing itself in the bottom. The slate bed in which this opening has been made is about 200 feet in thickness, in which there is an occasional stratum of hard material which does not split very readily, but which will answer very well for milling purposes, and can be made into very handsome tiles for flooring. A shaft is, or rather was, being put down a short distance further west, which would very materially enlarge the pit, and, of course, add largely to the productive capacity of the quarry. The hoisting machinery is complete in every particular, the slate blocks and debris, being taken up from any part of the large pit by means of a cable skip or traveling derrick, operated by drums like those in use at the iron and copper mines. A comparatively small force of men were turning out a daily average of 35 squares of the very finest roofing slates from this one pit, and it was very apparent how this product could be easily quadrupled by simply opening up as much more ground as could be economically worked with the aid of the present plant of machinery. It was then the intention to enlarge operations by setting a force at work in the old Huron Bay Company's pit about a quarter of a mile northeast of the engine house, and also by the renewal of work in a new pit about the same distance northwest which was partially opened in the summer of 1882, and where the slate is, if possible, even better than that found in the older workings; and this has probably been done ere this. It is perhaps needless to remark that the slate from this quarry has been pronounced equal, if not superior, to any produced elsewhere in the United States—so pronounced by all the architects who have given it an examination and trial. And what is true of this particular slate as to quality, may be held to apply to that of the entire belt, judging from the partial developments which have been made upon it at various points over a length of nearly twenty miles.

The trend of the slate formation in Baraga county is from northeast to southwest, the belt, which consists of several strata of splitting slate, and others suitable only for milling purposes, being, so far as known, about two miles wide. It lies in broad anticlinal and synclinal waves, as has been demonstrated by the developments at the Michigan quarry, where the first "post" was struck at a depth of less than 100 feet--the splitting plane of the bed showing to the north, and the "ribbon" carrying the slate again to the surface on the south. Not enough work has been done at any point, however, to show that other beds of good slate will not be found below this first ribbon; indeed, the belt would be of a character entirely different from any we have yet seen laid down in the books, if the single bed in which the Michigan Company is working should prove to be all there is of it of any value—though that one is enough upon which to base the expectation of a most prolific quarry.

Among the new slate properties recently brought into prominent notice, that on Silver river, in sections 6 and 7, town 50, range 32, is, perhaps, the most promising. The tract comprises the middle half of the two sections named, covering a length of two miles on the belt from north to south, and is due east from L'Anse a distance of about five miles. Silver river, a beautiful stream, with numerous falls and cascades, courses through its entire length, and cutting through the formation in many places, has, by the exposures thus made, saved a large amount of money that might otherwise have been required in the work of exploration. The stream will afford ample power for the operation of all the machinery that may be required for the working of the quarries, and the manufacture of the product into the various merchantable shapes, while the tract is at the same time heavily timbered with pine and hardwood, and has the further advantage of an excellent soil. Two small exploratory openings have been made in the slate, one on each section, and about one mile apart; but from the fact that in the one place a fine, hard, splitting slate is found, and in the other a soft milling slate which does not split so well, though equally as good in all other respects, and of the same color, I am led to think they may be in different beds. Just enough work has been done to show, in connection with the outcrops to be seen and the exposures made by the river, that the slate underlies nearly the entire tract, the diorite showing itself near both the north and south lines. Of the quality of the slate there can be no question; it is of a beautiful color, free from pyrites or other impurities, and not so closely jointed but that it can be quarried in almost any desired sizes. In this last respect the Silver river property possesses a decided advantage over the Huron Bay quarries, where the beds are more or less jointed, so that but a small proportion of the slate raised is suitable for other than roofing purposes. Here at Silver river, however, some beautiful slabs, 3½x5½ feet, have been taken out and sent to Chicago and Detroit for the inspection of billiard table and mantel manufacturers, and even the small amount of work thus far done shows conclusively that much larger sizes can be obtained in almost endless number. This, of course, is not so important a feature if the making of roofing slates is alone to be considered; but for other purposes it is of the utmost importance that the slate should be comparatively free from joints. The softer variety, on section 6 is, nevertheless, firm and tough enough to stand any amount of handling, and can be quarried in as large blocks as can conveniently be hoisted, after which it can be readily sawed into almost any size or shape desired. Mr. A. C. Davis, who has been chiefly instrumental in bringing this property into prominent notice, found no difficulty in squaring up the slabs referred to with the aid of a saw of his own contrivance. With the proper machinery, the cost of which would be a mere bagatelle to that of equipping an iron mine, hundreds of tons of this slate could daily be cut into sizes suitable for billiard-table beds, mantels, base-boards, tiles, and trimmings for the the better class of buildings, while from the other bed an unlimited amount of the best roofing slate could be obtained at a much less cost than at other properties less favorably located for economical quarrying. A good wagon road can be made over a comparatively level route to L'Anse, from whence the product of the quarries could be shipped to any of the lake cities direct by lake or rail.

A company has been organized to work this property, and it is not improbable that active operations will be commenced early next spring.

About four miles southwest of the last mentioned property, on section 16, town 50, range 33, Messrs. E. T. and R. R. Williams have made some most promising developments, having struck slate of the very best quality on both sides of the main track of the M. H. & O. railroad. Here a number of pits have been sunk and a considerable area of slate of the uniform good quality as that found at Huron Bay and Silver river uncovered; the work, however, has not yet assumed any greater proportions than that of a well-directed and most gratifying exploration—no attempt at quarrying having been made. There is also an excellent show of slate on the next section west, at what is, or was, known as the Lloyd quarry, but nothing is being done to develop it.

The time is near at hand when the slate interest of Baraga county will come to the front and take rank as one of the most important of our Michigan industries. Indeed, all that is now needed to make it a permanently profitable industry is the employment of the capital (backed by intelligent management), necessary to its thorough development. The demand, already large, is rapidly increasing, and it would be many years before a sufficient number of quarries could be developed to affect prices through the competition which always follows in the wake of over-production. The fortunes which have been made in the mining of iron and copper on Lake Superior can be duplicated by those who have the courage to judiciously sow the seed of a little surplus cash where a rich harvest may surely be anticipated—in the extensive, if not wholly inexhaustible, slate fields of Baraga county.

GOLD AND SILVER.

The existence of gold and silver bearing veins in the upper peninsula has long been known, but doubt has always been felt as to whether they would ever be found sufficiently large to pay for working. There are persons still living who assert that Dr. Douglass Houghton, the pioneer geologist and explorer whose name is so prominently identified with the early history of the Lake Superior region, claimed that he had found gold while engaged in his geological researches among the Huron mountains, and that but for his sudden and unexpected death he would have embodied the fact in an official report to the state authorities. We have never heard, however, that he left any memoranda concerning his reported discovery, and it is therefore probable that it was made during his last year of labor in this section, all the notes and papers concerning which were lost with him when he was drowned, in the fall of 1845. The silver-lead excitement of 1863–4, and the operations of the Lake Superior Silver-Lead and Holyoke Mining Companies, in the region adjacent to Marquette, has not been forgotten, nor yet the more recent interest excited by the discovery of silver in Ontonagon county. In the first instance the two companies named expended several hundred thousands of dollars in sinking shafts in veins of argentiferous galena, analyses of which gave from $10 to $200 to the ton, but, strange to say, neither of them ever built any smelting or other works for the reduction of the ores. The control of the first named company finally passed into the hands of a party of Cuban capitalists, who sent an expert to examine the property, which, on the strength of his report, was abandoned. The Holyoke was badly managed from the start, and through the adverse report of a foreign expert on the one hand, and ignorant management on the other, the whole region was condemned, without, so far as we have been able to learn, anything like intelligent exploration calculated to determine the size of the mineral bearing veins, or a practical test of the value of those actually found and opened. In the Iron River district, Ontonagon county, a number of shafts were sunk by as many different companies, in a contact vein which was shown by analyses to be rich in silver, a mill was built, and a number of silver bricks turned out, but these mines were likewise abandoned without, as I have always believed, being given a fair trial, either as to the extent of the veins or the actual amount of the precious metal they might contain. The shafts were shallow, and tested the veins to only a slight depth, while the mill runs were made from the rock dumps which had been picked over by hundreds of people in search of the richest specimens—though it has been maliciously hinted that not a few standard coins of the realm were thrown in to insure a "mill run" which would be perfectly satisfactory to those most immediately interested. That there was no foundation for any such statement I happen to be in a position to know; the true reason of the abandonment of the mines was probably that the veins were too small to permit of their being profitably wrought; that they contain silver there is no question of doubt.

But the fact that gold and silver does really exist in paying quantities in the upper peninsula is, I am much inclined to believe, about to be established beyond all question by the Ropes Gold and Silver Mining company, which was incorporated in August, 1881, and has since then explored the south half of the northwest quarter of section 29, town 48, range 27, where, in the year named, Mr. Julius Ropes, of Ishpeming, had previously discovered a net-work of small quartz veins well charged with the precious metals. The formation in which these veins occur is a portion of the range embraced in Dr. Rominger's geological report for 1881, and which he designates the "serpentine group"—a distinct range of rocks extending in an east and west course over a length of eight or ten miles. Dr. Rominger regards these serpentines as being of truly igneous origin. Associated with these eruptive rocks are sedimentary beds of dolomite and talcose and chloritic schists, together with eruptive diorite and quartzite. The rocks outcropping on the company's tract are, at the west end, diorite, feldspathic granite, (pyritiferous) schistose limestone, pyritiferous talcose and quartz and massive dolomite; at the east end a high ridge of serpentine. The beds of schist stand at a very high angle, the talcose, in which the net-work of veins referred to occur, being much broken up on the surface. The quartz veins, which seem to have been true fissures, intersect and traverse the bed in different directions, and vary from half an inch to 8 inches in thickness. Most of these veins are well charged with mineral, or the products of its decomposition.

Mr. Ropes patiently and persistently pursued his researches until at last he was rewarded by the discovery of what is believed to be the "mother" vein, from which the smaller ones are probably only ramifications. This has now been exposed in a number of pits and shafts for a continuous length of about 800 feet, the vein being from 6 to 15 feet in width, with regular and well defined walls, the foot-wall being a talcose schist heavily charged with mineral. It is well known that the talcose schist is the gold repository in all the richest gold fields in the world, while here the free gold and silver in the quartz is often plainly visible to the naked eye. A large number of analyses of this rock were made, many by parties wholly disinterested, the results varying all the way from $10 to $300 in gold and silver, the latter mineral, at first, predominating.

To test the value of the find, practically, a small five-stamp mill was erected in which 100 tons of the rock was treated with the following result:

PRODUCT FROM AMALGAM (FREE MILLING.)

Gold—34.073 ounces troy	$704 62	
Silver—89.83 " "	98 81	
		$803 43

VALUE OF CONCENTRATES.

Gold— 6.1 ounces troy	$126 14	
Silver—68 " "	74 80	
		$200 94
Total value of product		$1,004 37

The assays of the tailings gave, in the first half of the run, gold $9 per ton, and silver $2.72—a total of $11.72 per ton; in the last half $6 in gold and $1.92 in silver, or a total mineral value of $7.92.

In submitting these results to the public the management said: "It is due to parties interested, as well as to the general public, that all the facts connected with the working should be made known. And first, in regard to the rock which has been worked. This was mined from a shaft 7x9 which was sunk on the lode, which being at that point near the surface was only 4 to 5 feet thick; consequently two to three feet of the foot wall was taken out, and this, being a soft talcose slate, was finely broken up and mixed with the regular vein rock, and being difficult to separate, about 20 per cent. of the material worked was from the foot-wall. Again, the shaft having been commenced when the ground was deeply covered with snow, it was not cleared off and prepared, so that in cleaning up, much of the fine, richest rock was lost, being scattered in the debris. Some facts having an important bearing on the milling results should be noted. The value of the product of the first 60 tons, as showed by assays of both amalgam and concentrates, gave an average value of only about $6.50 per ton, and the last 40 tons about $14.85 per ton. This was caused partly by working rock rather below the average on the start; partly by the absorption of amalgam by the plate and battery, and also largely by the too limited use of mercury. This is shown conclusively by the increase of the product of the last 40 tons, which was almost entirely from the fine milling product. The value of the tailings is an important feature, and the decrease in the last part, as shown, from $11.72 to $7.92 per ton is significant and encouraging. With proper concentrating machinery, and further experience in working the rock, it is reasonable to expect a further saving of probably 50 per cent. or more of the amount now lost in the tailings."

Last summer other parties became interested in the property, and after a thorough investigation and a second mill test, entered into an arrangement whereby they agreed to furnish the necessary means to enlarge the mill to the extent of twenty additional stamps, and to open up the mine in proper shape. This addition has been made to the mill, which has been in operation a number of weeks with the most gratifying results —so much so that the shipment of gold and silver bullion by the company has become a matter of regular occurrence. In the meantime, two shafts have been sunk to a proper depth and connected, the underground workings showing, as I am informed by Hon. A. C. Davis, who examined them at my request, a regularly well defined mineral bearing quartz vein from 6 to 15 feet in width. In this connection I cannot do better than quote from the *Mining Journal* of late date an account of the present condition of the mine and mill:—"At the Ropes gold and silver mine the machinery is working smoothly and satisfactorily, without interruption from breakage, or other cause. The plant consists of an 80 h. p. boiler; an 80 h. p. single engine; a 25 h. p. single engine; 25 stamps; one crusher; 10 vanners; 2 pumps, and 1 donkey hoisting engine. The engines, stamps, vanners and hoisting machinery are all of approved make, and fulfill every expectation of the company in the results obtained from them. The old head of stamps will not be set up until spring. The boiler and engine are amply able to drive double the number of stamps and vanners now in use, and the writer of this entertains no doubt that by next spring the milling appliances at the mine will be increased so as to furnish full work for the motive power with which the Ropes plant is now supplied. The building—which is 96x73 on the ground and two stories high—is constructed so that an addition can be advantageously built upon the west side, and more stamps and vanners placed in position, as needed, without in the least disturbing the machinery now in operation.

The mineralized quartz comes from the mine in such shape that but a small proportion of it requires to be put through the Blake crusher, the major portion of the rock going directly to the stamps. On the suggestion of the working superintendent, Mr. J. Crow, two vanners have been provided for each gang of five stamps, and the result is a large saving in mineral. Tests have shown that not over $1.50 per ton of gold and silver now escapes in the tailings, and Mr. Crow assured the writer of this that the rock that they are now milling will yield fully $15 per ton. Since the mill started up on the 10th of the current month (Nov.), up to the 21st, the estimated product is $2,500, an average of $250 per day. This average can be very considerably increased, as the machinery is got into more perfect running order, and the mill "strikes its gait." The cost of milling at present is not over $4 per ton, charging against the work every possible item; with double the number of stamps and vanners it may be reduced to $3. The productiveness of the enterprise can be easily calculated from the figures above given, and that these will be substantiated by further developments the writer is compelled to believe, after an impartial examination of the mine itself, and the processes by which the mineral is extracted from the rock in which nature hid it away, seemingly to put human ingenuity and industry to the test, and provide their possessors a rich reward for scientific search and patient labor, well persisted in.

The water supply is now obtained from the swamp near the mine. A dam has been put in a few rods down, and this backs up the water so that all that is needed for the present requirements of the mill is had. The water, after being used in the mill, and that coming from the mine, is caught and held by the dam, and until the consumption becomes enhanced by extension of the milling operations, the present supply thereof will suffice. When more is needed, to provide for more extensive milling work, the Carp river—which is less than three-quarters of a mile distant—will supply it; and gold, bright, yellow gold from the Ropes mine, will provide the means to bring it hither.

In the mine itself, a force of sixteen men is now kept at work. On the first level of the Curry shaft, the east drift has been driven 140 feet from the shaft. At a distance of 100 feet it passed No. 1 shaft, and a cross-cut of seven feet was put through to this shaft. The cross-cut passed through mixed slate and quartz, separated, at that point, by only seven feet of rock of the grade through which the cross-cut was driven. The west drift from the Curry has been driven 60 feet. Toward the end it has became narrow at the bottom, but is again widening, and shows very rich quartz. On the second level, 100 feet from the surface, east and west drifts, to correspond with those described above, are being driven, the west one being the farthest advanced. A winze connects the east drifts on the first and second levels, and an uprise from the lower level will similarly connect the west drifts. All the work now going on underground is, strictly speaking, exploratory. When the rich ground now in sight can be attacked from stopes, an immense amount of rock can be speedily and cheaply mined. Considerable rock is taken out in the progress of this preliminary work, and there is a stock-pile of 300 tons on hand, so the mill will have an ample supply until they are ready to begin mining and taking out rock in a regular manner.

There are now 35 men employed in the mine and about the mill. The work is under the immediate supervision of Mr. Crow, who attends personally to every detail, and that he is thoroughly capable of making the Ropes show up for all there is in it is the sincere belief of the Mining Journal's representative. The location begins to present a cheerful aspect of thrift and activity. It is visited daily by persons whose curiosity prompts them to make a trip to the upper peninsula's pioneer gold mine. Their verdict upon it invariably is, that 'tis 'the biggest thing in the district,' and to this belief the writer unqualifiedly subscribes."

The same vein (apparently so) is being opened to the east and west of the Ropes. The Phillips Company, composed of Chicago capitalists, is opening on the vein immediately to the west of the Ropes, and about a mile and a half east, Crow & Miner are sinking in the same kind of rock. A mile or two still further east is the Berringer shaft, which is down 75 feet in a well defined quartz vein, the rock from which assays well in gold, with some silver. From various parts of the upper peninsula comes reports of similar finds, while within the city limits of Marquette, Capt. Smith Moore is cutting through a gold bearing formation 60 feet in width, all the rock from which appears to be more or less charged with gold. The favorable results attained at the Ropes mine have had the effect to attract wide-spread attention to this particular section, and it begins to look as if the upper peninsula might be on the eve of a great popular excitement, such as that which directed the wave of emigration towards the Pacific when gold was first discovered in California.

STATISTICAL TABLE.

Showing the Total Number of Net Tons of Refined Copper Produced by the Mines of Michigan. By Charles E. Wright, M. E., Commissioner of Mineral Statistics.

NAMES OF COPPER MINING COMPANIES.	*1855.		1855.		1856.		1857.		1858.		1859.		1860.		1861.	
	Tons.	Lbs.	Tons.	Lbs.	Tons	Lbs.	Tons.	Lbs	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.
[1] Adventure	34		31	34	71	1336	116	1941	57	1678	90	431	21	719	2	676
[2] Ætna																
[3] Peninsula (Albany & Boston)																
[2] Allouez																
[2] Amygdaloid																
[2] Arcadian																
[3] Atlantic (South Pewabic)																
Aztec	19		1	7467	25	1139	14	1361	3	251	9	493	8	503		
[2] Bay State (now part of Phoenix)																
[1] Caledonia (Old Nebraska)			27		2	1500					7	1000	20	400		
[3] Calumet & Hecla																
[1] Carp Lake													3	428		
[2] Central					32	903			71	1011	84	312	125	1370	70	139
[2] Clark (Pittsburgh & Boston)																
[2] Cliff	3,490		937	197	1,11[illegible]	934	1,180	850	1,130	433	707	1007	921	1393	964	11
[3] Concord																
[2] Copper Falls	158		100		104	10	153	1305	151	1852	173	174	255	818	280	11
[2] Delaware																
Douglass													13	1240		
[2] Eagle River		500		1500	1	600	1		3	637	6		4	1651		
[1] Evergreen Bluff	1	599	7	100	12	1110	23	942	3	665	19	811	31	1817	19	1187
[1] Flint Steel River	4	651	2						1	106						
[3] Franklin							3	699	56	1104	116	1211	157	1860	783	43
[2] Garden City											2				7	
Grand Portage																
Hancock (Sumner)															17	
[1] Hilton (Ohio)	2					705										
[3] Huron			3		12		35		21		22	1387	1	1000	19	
[1] Belt (International, Bohemian)											1	1903				
Isle Royal	58		93		232	1124	210	117	178	810	208	56	168	198	458	1274
[4] Island																
[1] Knowlton																
Lake Superior																
[2] Madison (Summit)					2		8									
[1] Mass							8	228	6		26	682				
[3] Mesnard																
[1] Minnesota	1,510		1,040		1,745	714	1,976		1,901	914	1,672	587	1,340	500	1,508	221
Minong																
National	78	1177	24	1302	88	483	158	957	132	804	244	176	539	609	691	1760
[1] Nonesuch																
[2] North American	450		153	1822	204	252	137	1958	19	919	11	852	(d)			
[2] Northwestern	72		77	900	40	820	2	1913								
[2] Norwich	167		108		110		58		19	1000						
[1] Ogima																
[1] Ohio Trap Rock	1	500							19	685						
[3] Osceola																
[2] Pennsylvania (Northwest)	555		99	80	1	1348	29	543	83	100	71	144	121	97	51	1920
[2] Ash Bed (Petherick)																
[3] Pewabic			2	301	53	1667	118	251	208	603	514	1949	958	1426	924	1902
[2] Phoenix	19		3		8		17				28	590	20	62	34	790
Quincy					6	1462	61	762	153	772	178	1114	970	414	1,282	852
[1] Ridge	30		35	631	36	1874	29	790	39	690						
[1] Rockland	10		58		146	1000	378	396	311	1140	239	1190	344	1000	388	358
[3] Centennial (Schoolcraft)																
[2] Seneca																
[3] Sheldon & Columbian																
[4] Saginaw							2	778	4	1107						
[2] Star				1000												
[4] St. Clair										635		1740	5		25	1000
[2] Superior					59	401	41	1036			16	186	3	1140		
[1] Toltec	50		30													
[1] Victoria (Forest)	130		36													
[1] Windsor			34													
[4] Wolverine																
Tamarack																
Sundry Co's and tributers	163															
Total No. net tons and pounds	7,002	1727	2,904	1334	4,108	1392	4,765	830	4,579	1916	4,463	1995	6,034	375	7,591	837
Total value (New York city)	$3,146,400		$1,586,160		$2,218,320		$2,382,500		$2,129,235		$2,239,591		$2,654,960		$3,187,995	
Highest and lowest price	29½—16		29½—24½		29½—24½		30—20		26¾—19¾		24¾—21		24—19⅞		27—17½	

NAMES OF COPPER MINING COMPANIES.	1862.		1863.		1864.		1865.		1866.		1867.		1868.	
	Tons.	Lbs.	Tons	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons.	Lbs.	Tons	Lbs.	Tons.	Lbs.
[1] Adventure	11	89				1755	3	1491	2	439				
[2] Ætna					3	857	2	131	29	996	31	858	1	1389
[3] Peninsula (Albany & Boston)	3	1982			3	1000	159	160	81	1906	31	493	117	536
[2] Allouez														
[2] Amygdaloid	48	1591	69	124	67	1795	209	964	170	668	80	1375	61	691
[2] Arcadian					2	593	2	1816						
[3] Atlantic (South Pewabic)									6	1475		1760	764	258
Aztec							4	700	16		40		36	
[2] Bay State (now part of Phoenix)							37	1000	105		57	115	(f)	
[1] Caledonia (Old Nebraska)			3	1730	15	1977							13	243
[3] Calumet & Hecla											675	1173	2,549	375
[1] Carp Lake				976	5	546	6	1185						
[2] Central	133	1972	278	1548	351	1855	546	1700	574	1842	687	795	1,353	1827
[2] Clark (Pittsburgh & Boston)														
[2] Cliff	1,002	960	1,050	354	675	1334	747	626	821	928	560	1725	613	1716
[3] Concord									4	1980	26	20	85	1185
[2] Copper Falls	2[illegible]9	299	159	1318	179	808	235		568	1169	1,128	1485	239	1384
[2] Delaware					29	700	51	492						
Douglass							3	809	8	209	32	1877	25	109
[2] Eagle River	2	1652								738	4	389		
[1] Evergreen Bluff	59	1257	70	1116			187	1213						
[1] Flint Steel River							108	959	50	1000				
[3] Franklin	733	645	639	684	605	1335	7[illegible]9	1481	819	994	701	455	734	1326
[2] Garden City			18		5				5	1397				
Grand Portage			177	1793	244	1104	241	1592					79	1282
Hancock (Sumner)	42	1325	55	1432	51	1000	37	1000	298	717	127		80	
[1] Hilton (Ohio)					5	1179	3	411	2	1767				
[3] Huron	69	1305	69	206	50	1745	238	11			683	1169	740	80
[1] Belt (International, Bohemian)			16	563	11	69	31	1502	34	1823				
Isle Royal	148	139	360	1841	291	386	341	1836	308	1336	381	852	147	1033
[4] Island														
[1] Knowlton	11	439	42	1451			98	724						
Lake Superior					1	432		1951	1	18				
[2] Madison (Summit)							7	881	17					
[1] Mass					4	1452	6	936	5	112	5	40	9	939
[3] Mesnard			21	1129	2		7	1600					2	1510
[1] Minnesota	1,260		838	1500	723		201	1000	195	1500	188	500	115	900
Minong														
National	432	1752	280	1179	314	516	348	168	3[illegible]3	1371	330	922	309	1820
[1] Nonesuch													1	1502
[2] North American														
[2] Northwestern			2	1920	3	650								
[2] Norwich					4	1730	26	1230						
[1] Ogima			26	1530	25		70	990	138	1310	81	480	99	1360
[1] Ohio Trap Rock														
[3] Osceola														
[2] Pennsylvania (Northwest)					81	1960	189	1369	64	90	163	660		
[2] Ash Bed (Petherick)	15	1822	66	1183	25	1228	4	1169					6	
[3] Pewabic	785	1281	845	1562	711	1857	865	1394	673	149	823	458	521	1523
[2] Phoenix	31	1590	72	118	142	187	165		101		98		130	
Quincy	1,153	218	1,115	1737	1,251	586	923	1500	1,172	1000	1,013	1000	727	1000
[1] Ridge					8	917	85	433	71	411	94	1537	86	
[1] Rockland	282		172		260	1624	108	1500	60		35	400	49	500
[3] Centennial (Schoolcraft)														
[2] Seneca														
[3] Sheldon & Columbian							36	912	66	1497	309	916	166	1118
[4] Saginaw								1760						
[2] Star							1	815	31	200	43	1723	65	665
[4] St. Clair	35		33	500	51	788	41	500	33		18	400	28	
[2] Superior									6	670				
[1] Toltec			3	1190				581	4	360			4	1820
[1] Victoria (Forest)														
[1] Windsor														
[4] Wolverine													500	
Tamarack														
Sundry Co's and tributers														
Total No. net tons and pounds	6,793	318	6,492	1344	6,245	1965	7,179	592	6,875	63	8,757	1607	10,467	124
Total value (New York city)	$3,634,255		$4,415,600		$5,870,300		$5,635,515		$4,629,375		$4,442,841		$4,940,424	
Highest and lowest price	32¾—20¾		39—29		55—39		50½—28		42—26½		29¼—21½		24½—21¾	

NAMES OF COPPER MINING COMPANIES.	1869.		1870.		1871.		1872.		1873.		1874.	
	Tons.	Lbs.	Tons.	Lbs.	Tons	Lbs.	Tons.	Lbs.	Tons	Lbs.	Tons.	Lbs.
[1] Adventure		1154	1	931	3	391	8	1055	2	1345	3	165
[2] Ætna									2	650		
[3] Peninsula (Albany & Boston)									33	200		
[2] Allouez	1	1575							(a) 10	1163	(a)504	134
[2] Amygdaloid	16	1010	23	1610					14	250	7	840
[2] Arcadian												
[3] Atlantic (South Pewabic)	823	857	186	617					431	1366	686	406
Aztec	87	1267	12	1288	6	1153	5	1550			6	1412
[2] Bay State (now part of Phoenix)												
[1] Caledonia (Old Nebraska)	52	1853	43	1508	1	1377	(b)					
[3] Calumet & Hecla	6,157	1771	7,030	1584	8,111	590	8,081	1836	9,424	265	10,062	1225
[1] Carp Lake												
[2] Central	903	1801	663	1156	716	662	623	56	751	1117	870	900
[2] Clark (Pittsburgh & Boston)							8	1749			3	1244
[2] Cliff	362	1247	222	381	71	238	59	386	375	1203	527	901
[3] Concord			4	1815	61	1626	71	1792	61	168	11	518
[2] Copper Falls	345	1400	386	990	239	883	260	862	643	540	535	359
[2] Delaware							81	1161	140	743	40	1271
Douglass												
[2] Eagle River												
[1] Evergreen Bluff	73	1662	55	1420	22	1046						
[1] Flint Steel River			15	889	46	500	22	1879	38	698	24	772
[3] Franklin	779	970	589		300	1000	186		183		283	1790
[2] Garden City												
Grand Portage	36	311										
Hancock (Sumner)	(a) 38		(a)203	1731	(a) 29	1710	(a) 27	366	(a) 44	1132	(a) 30	1365
[1] Hilton (Ohio)			1	1315								
[3] Huron	841	863	(a) 42	183	(a)131	1453	(a)276	1689	(a)237	1883	(a)125	1005
[1] Belt (International, Bohemian)			4	630	9	1482	32	1100	50	845	3	1535
Isle Royal	(a) 75	672			(a) 90	1217	(a)125	164	(a)120	100	(a) 90	836
[4] Island												
[1] Knowlton	53	977					8	1559	35	442	3	215
Lake Superior											2	1228
[2] Madison (Summit)												
[1] Mass	1	1213	1	1408	9	692		1903	4	265	5	1925
[3] Mesnard									4	1269		
[1] Minnesota	113	1500	200	1500	184		126		74	171	93	338
Minong												
National	128	947	130	660	205	1086	168	770	83	1870	71	52
[1] Nonesuch	1	1261				257					13	1450
[2] North American												
[2] Northwestern												
[2] Norwich	2	1300										
[1] Ogima	9	45			4	1839						
[1] Ohio Trap Rock												
[3] Osceola											468	
[2] Pennsylvania (Northwest)												
[2] Ash Bed (Petherick)							5	570	6	1348	86	291
[3] Pewabic	480	409	273		222	600	233	1000	286	400	147	607
[2] Phoenix	398	630	499	1000	609	1862	364	470	260	1080	699	400
Quincy	1,208	1365	1,248	1777	1,204	1[illegible]01	1,1[illegible]4	1134	1,400		1,525	654
[1] Ridge	126	1840	122	1400	175	150	128	1910	115	1140	187	113
[1] Rockland	59	1000	47	1000	30		25	1000	11	1400	22	1260
[3] Centennial (Schoolcraft)	(a) 4	290	(a)213	366	(a)371	1228	(a) 192	242	(a)154	1785	(a) 5	618
[2] Seneca								1603				
[3] Sheldon & Columbian	93	368										
[4] Saginaw								535				
[2] Star	23	197					9	72	40	1867	2	1400
[4] St. Clair	2	521										
[2] Superior												
[1] Toltec			1	1570	1	1903		1890				
[1] Victoria (Forest)												
[1] Windsor												
[4] Wolverine	8	1022	84		8		5	1220	2	800	16	1120
Tamarack												
Sundry Co's and tributers												
Total No. net tons and pounds	13,312	1301	12,311	759	12,873	448	12,276	1523	15,145	1505	17,167	389
Total value (New York city)	$6,230,016		$5,096,752		$5,728,485		$7,979,400		$8,726,100		$8,009,356	
Highest and lowest price	27—21½		22¾—19		27¼—21¼		45—27¼		35—20		25—19	

NAMES OF COPPER MINING COMPANIES.	1875.		1876.		1877.		1878.		1879.		1880.	
	Tons	Lbs.	Tons	Lbs	Tons	Lbs	Tons	Lbs.	Tons	Lbs.	Tons	Lbs
[1] Adventure	15	470	20	784	32	6[illegible]9	27	115	10	1785	1	[illegible]
[2] Ætna												
[3] Peninsula (Albany & Boston)			3	15	5	1998		1710				
[2] Allouez	(a)692	1574	(a)780	1875	(a)650	27[illegible]	565	[illegible]	715	1152	679	[illegible]
[2] Amygdaloid								1259				
[2] Arcadian									12	760		
[3] Atlantic (South Pewabic)	783	1036	917	1011	1,027	704	1,132	1[illegible]92	1,153	1822	1,170	[illegible]
Aztec	8	252	13	1378	14	1934	11	1392	8	737	2	[illegible]
[2] Bay State (now part of Phoenix)												
[1] Caledonia (Old Nebraska)												
[3] Calumet & Hecla	10,736	1954	10,847	737	11,284	468	12,025	1128	13,135	91[illegible]	15,857	[illegible]
[1] Carp Lake												
[2] Central	733	952	1,080	1400	907	1610	943	1013	809	1495	1,013	
[2] Clark (Pittsburgh & Boston)	33	1475	13	774	17	813	10	1520		340		
[2] Cliff	581	873	450	116	80	1319	207	115	67	336	39	9
[3] Concord		440									5	46
[2] Copper Falls	203	1587	8	1488	5	1950	5	1790			3	61
[2] Delaware	12	1220	88	1701	16	1417	140	345	70	12	116	1811
Douglass					1	1258						
[2] Eagle River												
[1] Evergreen Bluff							35	1873	15	405	5	651
[1] Flint Steel River	16	1054	15	115	13	67	19	[illegible]	21	1192	14	[illegible]
[3] Franklin	583	800	963	641	1,169	1817	1,299	1518	1,114	1703	1,168	4
[2] Garden City												
Grand Portage							17	124	17	1423		
Hancock (Sumner)	(a) 11	229							3	1294	38	[illegible]
[1] Hilton (Ohio)					1	1555	3	807	1	50	1	1602
[3] Huron	(a) 31	1289	(a) 31	1857	(a) 41	161	32	1100	14	1760	35	[illegible]
[1] Belt (International, Bohemian)	4	762	5	653	8	1703		1188		417		
Isle Royal	(a) 48	682	(a) 14	199	(a) 15	1985	15	1933	13	880	38	[illegible]
[4] Island			24	340	41	867						
[1] Knowlton	3	562			2	1975	4	629				
Lake Superior					1	106				1080		
[2] Madison (Summit)								1676				
[1] Mass	1	1011	10	1952	54	238	206	339	288	294	258	[illegible]
[3] Mesnard					3	589						
[1] Minnesota	66	1119	14	954	56	1148	87	1027	46	762	16	
Minong	24	344	57	537	52	892	45	596	36	515	13	140[illegible]
National	49	878	83	647	34	737	11	736	8	1506		
[1] Nonesuch	24	1667							15	1973	27	1584
[2] North American												
[2] Northwestern												91[illegible]
[2] Norwich												
[1] Ogima							1	800	8	1937	2	18[illegible]
[1] Ohio Trap Rock												
[3] Osceola	665	303	846	1737	1,382	777	1,352	1998	1,598	1387	1,691	15[illegible]
[2] Pennsylvania (Northwest)												
[2] Ash Bed (Petherick)	76	946	42	1224	7	632						
[3] Pewabic	312	1271	284	995	346	1777	261	1826	168	519	485	[illegible]
[2] Phoenix	702	276	698	530	511	493	150	1172	271	1426	218	[illegible]
Quincy	1,399	281	1,536	1171	1,427	336	1,480	449	1,323	1458	1,848	[illegible]
[1] Ridge	164	447	145	18	148	815	125	1837	107	1469	111	[illegible]
[1] Rockland	5	1440	28	1600	19	700	8	1877		1924		
[3] Centennial (Schoolcraft)												
[2] Seneca					3	1810	3	1809				
[3] Sheldon & Columbian						1800		1622	24	1464	23	[illegible]
[4] Saginaw												
[2] Star											6	[illegible]
[4] St. Clair			1	1936	2	1870		1965		1476		
[2] Superior												
[1] Toltec				752		861	2	52				
[1] Victoria (Forest)												
[1] Windsor												
[4] Wolverine	24		41	1800	27	1000	2	186	7	1527	3	[illegible]
Tamarack												
Sundry Co's and tributers												
Total No. net tons and pounds	18,019	1497	19,135	997	19,513	671	20,943	1266	21,835	1529	24,859	[illegible]
Total value (New York city)	$8,180,626		$7,998,430		$7,327,888		$6,920,540		$7,327,350		$9,947,67[illegible]	
Highest and lowest price	23½—21½		23—18¾		20⅜—17½		17½—15¾		21¾—15		24½—18	

NAMES OF COPPER MINING COMPANIES.	1881.		1882.		1883.		Total.		NAMES OF COPPER MINING COMPANIES.
	Tons	Lbs	Tons	Lbs	Tons	Lbs	Tons	Lbs	
[2] Cliff	[illegible]	[illegible]							Cliff.
[3] Concord	11	[illegible]							Concord.
[2] Copper Falls	[illegible]	[illegible]	[illegible]	[illegible]					Copper Falls.
[2] Delaware		[illegible]	[illegible]	[illegible]	11				Conglomerate Delaware.
Douglass									Douglass.
[2] Eagle River									Eagle River.
[1] Evergreen Bluff		[illegible]							Evergreen Bluff.
[1] Flint Steel River		[illegible]							Flint Steel River.
[3] Franklin	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		Franklin.
[1] Hilton (Ohio)	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	21	1819	Hilton (Ohio.)
[3] Huron	[illegible]	[illegible]	192	[illegible]	[illegible]	[illegible]	4,516	1738	Huron.
National	7	[illegible]	8	1060	13	6	5,324	251	National.
[1] Nonesuch	59	1061	23	450			168	1205	Nonesuch.
[2] North American									North American.
Total No. net tons and pounds	27,274	[illegible]	[illegible]	[illegible]	[illegible]	464	[illegible]		
Total value (New York city)	$9,[illegible]		[illegible]		[illegible]		[illegible]		
Highest and lowest price	[illegible]		[illegible]						

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[1] Mine in Ontonagon county. [2] Mine in Keweenaw county. [3] Mine in Houghton county. [4] Mine in Isle Royal county. [5] Mine in Houghton and Keweenaw counties. * Previous to 1855. † Now Flint Steel. *a* May 1st of the following year. *b* Consolidated with the Flint Steel River. *d* Consolidated with Pittsburgh & Boston. *f* Sold to Phoenix company.

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